

# **DEVELOPMENT OF NEW PEDESTRIAN CROSSING GUIDELINES IN UTAH**

## **Technical Document**

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<b>16. Abstract</b>  <p>A total of 8,838 pedestrian-vehicle collisions occurred in Utah between 1992 and 2001. An average of 1,037 crashes per year occurred between 1992 and 1996. With the removal of private property incidents from the statewide crash records system, the trend in the annual number of pedestrian-vehicle crashes began to decrease (to 655 in 2001). A total of 91.5% of the collisions occurred in Utah's six urban counties: Cache, Davis, Salt Lake, Utah, Washington, and Weber. A total of 335 fatal pedestrian-vehicle crashes occurred between 1992 and 2001; there was no trend in the annual number of fatal incidents, implying that the proportion of crashes that were fatal increased during the study period. Most of the fatal crashes (86.3%) occurred in the urban counties. The 8,838 collisions occurred at 6,610 crash sites; 5,520 of these were single-crash sites, while 1,090 were the scene of multiple crashes. At least one crash occurred in each of Utah's 29 counties, and 49.9% of the sites were in Salt Lake County. There were 613 two-crash, 215 three-crash, 116 four-crash, 59 five-crash, 34 six-crash, 22 seven-crash, 6 eight-crash, and 11 nine-crash sites; in addition, 14 sites were the scene of eleven or more crashes. A sample of 294 crash sites was identified. The selected sites tended to have high "crash severity" scores, based on a system that awarded points ranging from 0.1 for a "no injury" crash to 1,000 for a fatal crash. A total of 980 crashes occurred at the 294 sites. The sampled crashes tended to occur along minor arterials with four through lanes, at signalized intersections during the daytime under clear conditions. The peak month was October, and Friday was the peak day. The peak hour occurred between 5:30 and 6:30 PM; the peak 4-hour period was from 4:00 to 8:00 PM, and the peak 8-hour period was from 2:30 to 10:30 PM. About two-thirds of the sites were visited. Data were collected on the type of traffic control, pedestrian signal times, speed limits, crossing facilities (if any), distances to the nearest marked crossings, sidewalks, nearby transit stops, pavement width (i.e., number of lanes and shoulders), the type of median (if any), adjacent land uses, and lighting. The data were supplemented with information from 27 Police Accident Reports on fatal crashes that occurred during 2000 and 2001. To extend the research, pedestrian activities at 14 intersections having countdown pedestrian indicators (CPIs) and two sites having crossing flags were examined. A total of 987 single or groups of pedestrians were observed at the CPIs. A total of 61% of the pedestrians who arrived after the countdown had started crossed successfully; 25% crossed and were still crossing at CPI = 0, and 14% did not cross. A total of 10% of the pedestrians were violators who crossed against the signal; 4% of the pedestrians did not have enough time to cross despite starting immediately after the walking person appeared. A total of 97 pedestrians were observed at the sites with crossing flags. Of the 77 pedestrians who crossed when motor vehicles were approaching, only 9 (11.7%) used the flags. Both flag sites were adjacent university campuses, so it may be useful to perform investigations elsewhere. The Final Report, for which the Technical Document is a companion, uses these findings to develop example pedestrian crossing guidelines.</p>					
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## **Abstract**

A total of 8,838 pedestrian-vehicle collisions occurred in Utah between 1992 and 2001. An average of 1,037 crashes per year occurred between 1992 and 1996. With the removal of private property incidents from the statewide crash records system, the trend in the annual number of pedestrian-vehicle crashes began to decrease (to 655 in 2001). A total of 91.5% of the collisions occurred in Utah's six urban counties: Cache, Davis, Salt Lake, Utah, Washington, and Weber. A total of 335 fatal pedestrian-vehicle crashes occurred between 1992 and 2001; there was no trend in the annual number of fatal incidents, implying that the proportion of crashes that were fatal increased during the study period. Most of the fatal crashes (86.3%) occurred in the urban counties. The 8,838 collisions occurred at 6,610 crash sites; 5,520 of these were single-crash sites, while 1,090 were the scene of multiple crashes. At least one crash occurred in each of Utah's 29 counties, and 49.9% of the sites were in Salt Lake County. There were 613 two-crash, 215 three-crash, 116 four-crash, 59 five-crash, 34 six-crash, 22 seven-crash, 6 eight-crash, and 11 nine-crash sites; in addition, 14 sites were the scene of eleven or more crashes. A sample of 294 crash sites was identified. The selected sites tended to have high "crash severity" scores, based on a system that awarded points ranging from 0.1 for a "no injury" crash to 1,000 for a fatal crash. A total of 980 crashes occurred at the 294 sites. The sampled crashes tended to occur along minor arterials with four through lanes, at signalized intersections during the daytime under clear conditions. The peak month was October, and Friday was the peak day. The peak hour occurred between 5:30 and 6:30 PM; the peak 4-hour period was from 4:00 to 8:00 PM, and the peak 8-hour period was from 2:30 to 10:30 PM. About two-thirds of the sites were visited. Data were collected on the type of traffic control, pedestrian signal times, speed limits, crossing facilities (if any), distances to the nearest marked crossings, sidewalks, nearby transit stops, pavement width (i.e., number of lanes and shoulders), the type of median (if any), adjacent land uses, and lighting. The data were supplemented with information from 27 Police Accident Reports on fatal crashes that occurred during 2000 and 2001. To extend the research, pedestrian activities at 14 intersections having countdown pedestrian indicators (CPIs) and two sites having crossing flags were examined. A total of 987 single or groups of pedestrians were observed at the CPIs. A total of 61% of the pedestrians who arrived after the countdown had started crossed successfully; 25% crossed and were still crossing at CPI = 0, and 14% did not cross. A total of 10% of the pedestrians were violators who crossed against the signal; 4% of the pedestrians did not have enough time to cross despite starting immediately after the walking person appeared. A total of 97 pedestrians were observed at the sites with crossing flags. Of the 77 pedestrians who crossed when motor vehicles were approaching, only 9 (11.7%) used the flags. Both flag sites were adjacent university campuses, so it may be useful to perform investigations elsewhere. The Final Report, for which the Technical Document is a companion, uses these findings to develop example pedestrian crossing guidelines.

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## **CHAPTER 1. Research Approach**

The objective of this research was to develop new pedestrian crossing guidelines for the State of Utah. The purpose of this document is to provide technical background and support for the Final Report. The Final Report contains a set of proposed pedestrian crossing guidelines for Utah. The problems identified in the report, for which the guidelines have been prepared in response, are based on findings from pedestrian-vehicle crash sites. These crash sites are discussed and described in this report, the Technical Document. The research approach was to, first, gather data on pedestrian-vehicle crashes in Utah. Particular attention was paid to the locations at which the crashes occurred, as well as the severity of the crashes. Locations at which pedestrian-vehicle crashes either recurred or were fatal during a ten-year study period (1992-2001) were identified as candidates for further study. The pedestrian-related infrastructure at candidate sites was investigated, along with the characteristics of the crashes, motor vehicle-related infrastructure, and demand information. By examining pedestrian-vehicle crash sites, a total of 21 common themes, issues and concerns were revealed. (Additional concerns were revealed, but the research team considered these to be more properly addressed by education and vigilance, rather than engineering-related guidelines). These themes, issues and concerns were indicators of pedestrian crossing improvement needs.

This report discusses Utah's pedestrian-vehicle crash data in some detail. Chapter 2 provides an overview of Utah's pedestrian-vehicle crashes, including statewide statistics and trends. Chapter 3 features a discussion of Utah's pedestrian-vehicle crash sites, the procedure used to develop a sample of sites, and a list of the sampled sites. Chapter 4 considers the accuracy and precision of the crash data. Some caveats are presented regarding crash reporting and location identification. Chapter 5 examines the pedestrian-related infrastructure at the crash sites, with an emphasis on the locations that were visited by the research team. The characteristics of the crashes (as opposed to the crash sites) are discussed in Chapter 6. An investigation of fatal pedestrian-vehicle crashes, drawing from the information provided by a selection of Police Accident Reports, is presented in Chapter 7. Chapter 8 diverges a bit from the earlier chapters to examine the effectiveness of pedestrian crossing enhancements that have been implemented in Utah. These include countdown pedestrian indicators and pedestrian crossing flags. Finally, the "raw" data on pedestrian-vehicle crash sites are included in the Appendix.

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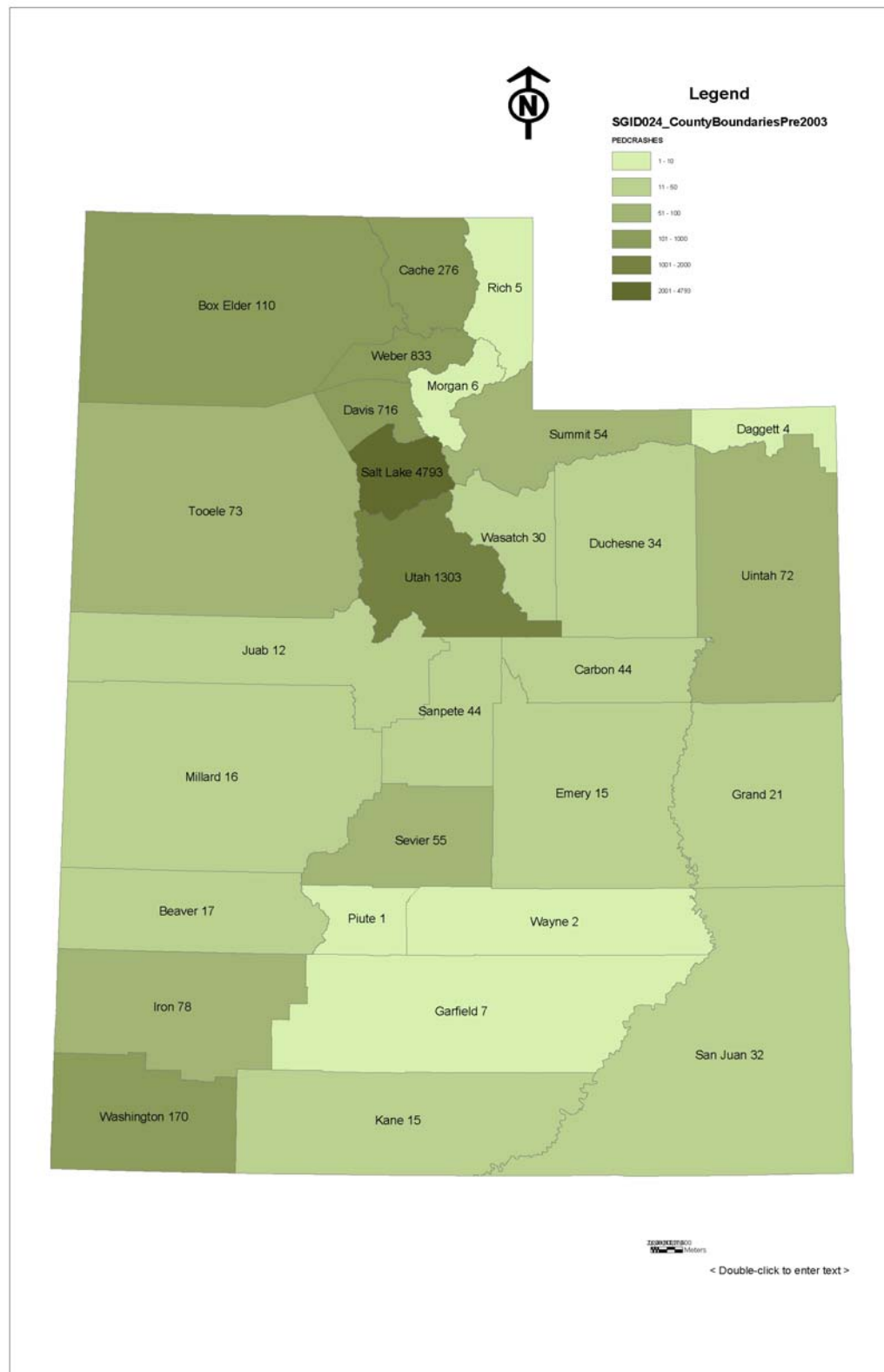
## CHAPTER 2. Utah Pedestrian Safety Overview

The Crash Data Delivery System (CDDS), maintained by UDOT, provided raw pedestrian-vehicle crash data from throughout Utah for a 10-year study period (1992-2001). These data were supplemented by information from the Utah Crash Outcomes Data Evaluation System (Utah CODES) for years 1997-2001. Table 1 summarizes Utah's pedestrian-vehicle crashes by year and county. As shown, 8,838 pedestrian-

**Table 1. Pedestrian-Vehicle Crashes in Utah by County: 1992-2001 (CDDS)**

County	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	1992-2001
Beaver	1	1	1	4	3	1	4	1	0	1	17
Box Elder	19	8	8	14	14	9	3	11	11	13	110
Cache	27	30	47	37	34	22	16	24	18	21	276
Carbon	7	8	8	3	5	3	4	2	3	1	44
Daggett	0	3	0	0	0	0	0	0	0	1	4
Davis	80	86	87	81	110	65	43	48	58	58	716
Duchesne	3	5	3	5	7	3	2	4	0	2	34
Emery	1	2	2	2	7	0	0	0	1	0	15
Garfield	0	0	1	1	2	1	1	1	0	0	7
Grand	1	1	3	1	7	1	1	2	3	1	21
Iron	15	9	13	6	8	7	7	6	3	4	78
Juab	2	2	0	1	2	0	2	1	1	1	12
Kane	1	3	3	0	6	1	0	0	0	1	15
Millard	0	2	1	3	2	3	1	2	2	0	16
Morgan	2	0	2	0	2	0	0	0	0	0	6
Piute	0	0	1	0	0	0	0	0	0	0	1
Rich	1	1	0	0	2	0	1	0	0	0	5
Salt Lake	556	571	583	503	610	463	429	366	356	356	4,793
San Juan	5	1	6	1	5	6	1	5	1	1	32
Sanpete	4	4	5	2	6	6	5	5	2	5	44
Sevier	8	5	4	5	10	6	5	4	5	3	55
Summit	7	7	3	2	10	4	6	4	7	4	54
Tooele	7	6	10	8	11	5	5	4	9	8	73
Uintah	7	16	14	14	5	6	3	1	5	1	72
Utah	141	155	165	134	131	130	124	127	117	79	1,303
Wasatch	4	3	4	3	0	4	3	2	3	4	30
Washington	17	10	15	11	26	19	15	24	14	19	170
Wayne	1	0	1	0	0	0	0	0	0	0	2
Weber	109	93	78	84	109	78	67	76	68	71	833
TOTAL	1,026	1,032	1,068	925	1,134	843	748	720	687	655	8,838

vehicle collisions occurred in Utah between 1992 and 2001. Incidents occurring on private property were not recorded in the database after 1996, hence the apparent drop in pedestrian-vehicle incidents from 1996 to 1997. Between 1992 and 1996, the annual number of incidents remained fairly stable. Between 1997 and 2001, the trend was toward a decreasing number of incidents. In fact, the number of pedestrian-vehicle crashes decreased at a rate of 5.2% per year between 1997 and 2001. Multiple factors were likely involved in this trend, including a decreased amount of walking, improved pedestrian awareness of motor vehicles, improved driver awareness of pedestrians, infrastructure improvements such as lighting and signing, enforcement, and others. Despite these interventions, and the change in crash reporting policy, the research considered the entire ten years of data. The research team decided that the richness of ten years' worth of pedestrian-vehicle crash information should be utilized. Figure 1 shows the 10-year number of pedestrian-vehicle crashes by county.



**Figure 1. Map: Pedestrian-Vehicle Crashes in Utah by County (1992-2001)**

The greatest number of pedestrian-vehicle crashes occurred, as expected, in Utah's most populous county, Salt Lake. A total of 4,793 crashes occurred, representing 54.2% of the State's crashes. The second greatest number of crashes occurred in Utah County, at 1,303 or 14.7% of the State's incidents. Salt Lake County was home to 39.6% of Utah's residents as of the year 2000 census. The portion of pedestrian-vehicle crashes occurring in Salt Lake County, therefore, exceeded the county's proportion of the state's population. There may be several reasons behind this finding, including a greater visitor population in Salt Lake County than in other counties (and a consequential lack of familiarity with the transportation system), and a higher level of pedestrian exposure to motor vehicle activity. Urban counties – Cache, Davis, Salt Lake, Utah, Washington, and Weber – experienced 8,091 pedestrian-vehicle crashes, or 91.5% of the State's total. Of the remaining 747 crashes, 69.1% (516) occurred in counties with small urban areas (urbanized concentrations with populations of 5,000 to 50,000: Box Elder, Carbon, Iron, Sevier, Summit, Tooele, Uintah, and Wasatch). Thus, 91.5% of the State's pedestrian-vehicle crashes occurred in urban counties, 5.8% occurred in counties with small urban areas, and 2.6% occurred in the 15 rural counties. Although pedestrian safety is a statewide issue, pedestrian safety breaches most commonly occurred in urban settings during the study period.

Fatal pedestrian-vehicle crash activity is summarized in Table 2. A total of 335 fatal pedestrian-vehicle crashes, resulting in over 335 fatalities, occurred in Utah between 1992 and 2001. Unlike the all-incidents summary in Table 1, there is no discernible trend in fatal crashes. That is, the number of fatal crashes per year remained fairly stable between 1992 and 2001. The average annual number of fatal crashes was 33.5, and the standard deviation was 5.21, yielding a low coefficient of variation (COV) of 0.156. The low COV indicates that there was not a lot of variation about the mean. The suggestion is that despite the trend toward a decreasing number of pedestrian-vehicle incidents, the complementary trend is toward a gradual *increase* in the portion of crashes resulting in fatalities. For example, in 1992, 3.7% of all pedestrian-vehicle crashes were fatal, whereas in 2001, 4.3% were fatal. Nearly half of the fatal crashes (163 or 48.7%) occurred in Salt Lake County. The six urban counties saw 289 (86.3%) of the fatal crashes, while the eight "small urban" counties experienced 34 (10.1%) of the incidents. The remaining twelve (3.6%) fatal pedestrian-vehicle crashes occurred in rural counties. Notably, 3.6% of the urban, 6.6% of the small urban, and 5.2% of the rural pedestrian-vehicle crashes were rural. The indication is that pedestrian-vehicle crashes tended to be more severe in small urban and rural settings than in urban ones.

The numbers of pedestrian-vehicle crash sites by county are summarized in Table 3. As shown, the 8,838 pedestrian-vehicle crashes occurred at 6,610 different sites throughout the State. A total of 5,520 of these sites experienced a single incident during the ten-year study period. That is, 83.5% of the sites were one-incident sites. Nearly half of the 6,610 sites – 3,301 or 49.9% -- were located in Salt Lake County. An additional 1,040 sites (15.7%) were located in Utah County. A total of 5,927 crash sites (89.7%) were located in the six urban counties. A further 466 sites (7.0%) were located in the eight "small urban" counties, leaving 217 sites (3.3%) in rural areas. Although all 29 counties experienced at least one pedestrian-vehicle crash during the ten-year study period, 18 of the counties featured one or more *multiple*-crash sites. The 18 counties included all six urban, seven of the eight small urban, and five of the rural counties. There were 1,090 multiple-crash sites in Utah between 1992 and 2001; 651 (59.7%) of these were located in Salt Lake County. A total of 157 (14.4%) of the multiple-crash sites were located in Utah County. Most (1,042 or 95.6%) of the multiple-crash sites were located in the six urban counties. A total of 37 (3.4%) of the multiple-crash sites were situated in the "small urban" counties, while the remaining 11 (1.0%) were in rural counties. These findings suggest that recurring pedestrian-vehicle crashes are primarily an urban phenomenon. Further discussion of the multiple-crash sites is offered in Chapter 3 of this report.

Table 3 also lists, in superscripts, the numbers of fatal crash sites in each county. The 335 fatal pedestrian-vehicle crashes occurred at 328 sites, suggesting that fatal crashes seldom recurred at the same site. Two fatal crashes occurred at each of seven sites; the other 321 fatal crashes were dispersed among 321 sites. Five of the multiple-fatal crash sites were in Salt Lake County; one was in Utah County, and the other was in Weber County. Of the 5,520 single-crash sites, 224 (4.1%) were fatal crash sites. The

remaining 111 fatal crashes took place at multiple-crash sites; at one of the two-crash sites, both of the incidents were fatal. At the other 110 sites, one crash was fatal, while the other crashes were nonfatal.

It was beyond the scope of this research to conduct a full analysis of the pedestrian-vehicle crash trends in Utah. As suggested earlier, a number of factors are involved in these trends. Extensive before-after examinations of highway and safety improvements, demographic studies (i.e., the impacts of an aging population, teenage driving restrictions), and vehicle design improvements would be needed.

**Table 2. Fatal Pedestrian-Vehicle Crashes in Utah by County: 1992-2001**

County	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	1992-2001
Beaver	0	0	0	0	0	0	0	0	0	0	0
Box Elder	2	0	3	2	1	0	0	1	2	0	11
Cache	0	0	2	0	1	1	0	2	1	1	8
Carbon	0	1	1	0	0	0	0	0	0	0	2
Daggett	0	0	0	0	0	0	0	0	0	1	1
Davis	3	2	5	4	4	3	3	5	1	3	33
Duchesne	0	1	0	0	0	0	0	0	0	0	1
Emery	1	0	0	1	1	0	0	0	0	0	3
Garfield	0	0	0	0	0	0	0	0	0	0	0
Grand	0	0	0	1	0	0	0	0	0	0	1
Iron	1	0	1	0	0	0	1	0	0	1	4
Juab	0	0	0	0	0	0	0	0	0	1	1
Kane	0	0	0	0	0	0	0	0	0	0	0
Millard	0	0	0	0	0	1	0	0	0	0	1
Morgan	0	0	0	0	0	0	0	0	0	0	0
Piute	0	0	0	0	0	0	0	0	0	0	0
Rich	0	0	0	0	0	0	0	0	0	0	0
Salt Lake	16	11	15	20	15	20	20	14	19	13	163
San Juan	1	1	0	0	0	0	0	0	0	1	3
Sanpete	0	0	0	0	0	0	0	1	0	0	1
Sevier	1	0	0	0	1	1	0	0	0	0	3
Summit	1	0	0	0	0	0	1	0	0	0	2
Tooele	0	1	0	0	1	0	1	1	2	1	7
Uintah	1	1	1	1	0	0	0	0	0	0	4
Utah	3	1	2	4	5	4	8	6	2	1	36
Wasatch	0	0	0	1	0	0	0	0	0	0	1
Washington	1	0	2	1	0	0	1	2	0	1	8
Wayne	0	0	0	0	0	0	0	0	0	0	0
Weber	7	5	2	4	3	4	6	3	3	4	41
TOTAL	38	24	34	39	32	34	41	35	30	28	335

**Table 3. Number of Sites with Single & Multiple Pedestrian-Vehicle Crashes in Utah: 1992-2001**

	Number of Crashes per Site ( <i>top row</i> ) & Number of Sites ( <i>subsequent rows</i> )																
County	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	19	Total
Beaver	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
Box Elder	94 <sup>9</sup>	5 <sup>1</sup>	2 <sup>1</sup>	1	0	0	0	0	0	0	0	0	0	0	0	0	102
Cache	188 <sup>6</sup>	17	5 <sup>1</sup>	2	2	0	3 <sup>1</sup>	0	0	0	0	0	0	0	0	0	217
Carbon	38 <sup>2</sup>	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41
Daggett	4 <sup>1</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Davis	517 <sup>28</sup>	43 <sup>4</sup>	14 <sup>1</sup>	7	2	2	0	0	1	0	1	0	0	0	0	0	587
Duchesne	30	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
Emery	15 <sup>3</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
Garfield	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Grand	13 <sup>1</sup>	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
Iron	56 <sup>4</sup>	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	65
Juab	12 <sup>1</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Kane	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
Millard	16 <sup>1</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Morgan	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3
Piute	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rich	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Salt Lake	2,650 <sup>89</sup>	330 <sup>26</sup>	126 <sup>17</sup>	81 <sup>5</sup>	46 <sup>7</sup>	26 <sup>3</sup>	16	5 <sup>1</sup>	8 <sup>1</sup>	4 <sup>1</sup>	2 <sup>1</sup>	3 <sup>1</sup>	1 <sup>1</sup>	1	1	1	3,301
San Juan	27 <sup>3</sup>	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	29
Sanpete	40 <sup>1</sup>	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42
Sevier	41 <sup>3</sup>	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	46
Summit	54 <sup>2</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54
Tooele	58 <sup>6</sup>	2 <sup>1</sup>	1	2	0	0	0	0	0	0	0	0	0	0	0	0	63
Uintah	64 <sup>4</sup>	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68
Utah	883 <sup>29</sup>	96 <sup>2</sup>	41 <sup>3</sup>	10 <sup>1</sup>	3	5 <sup>1</sup>	1	0	1	0	0	0	0	0	0	0	1,040
Wasatch	24 <sup>1</sup>	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
Washington	134 <sup>7</sup>	13	2	1 <sup>1</sup>	0	0	0	0	0	0	0	0	0	0	0	0	150
Wayne	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Weber	513 <sup>23</sup>	79 <sup>13</sup>	20 <sup>1</sup>	10 <sup>1</sup>	5 <sup>1</sup>	1 <sup>1</sup>	2 <sup>1</sup>	1	1	0	0	0	0	0	0	0	632
TOTAL	5,520 <sup>224</sup>	613 <sup>47</sup>	215 <sup>24</sup>	116 <sup>8</sup>	59 <sup>8</sup>	34 <sup>5</sup>	22 <sup>2</sup>	6 <sup>1</sup>	11 <sup>1</sup>	4 <sup>1</sup>	3 <sup>1</sup>	3 <sup>1</sup>	1 <sup>1</sup>	1	1	1	6,610

NOTE: A superscript indicates the number of sites that featured a fatal pedestrian-vehicle crash. A single fatality occurred at these sites, except for one of Weber County's two-crash sites, one of Salt Lake County's three-crash sites, one of Utah County's four-crash sites, two of Salt Lake County's five-crash sites, one of Salt Lake County's eight-crash sites, and one of Salt Lake County's thirteen-crash sites; two fatalities occurred at each of these sites.

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## CHAPTER 3. Recurrent Pedestrian-Vehicle Collision Sites

### Identification of Recurrent Pedestrian-Vehicle Collision Sites

The CDDS indicates crash locations according to milepost and route number. A route number can be one of three types: State highway system (including Interstate freeways), federal-aid urban system, and federal-aid secondary system. The milepost of a crash site identifies the site's location along a given route. In some cases, the milepost in the CDDS is given as "0.1;" these locations are not on the federal-aid system and are either on non-federal-aid roads, or are on private property. A site was considered to be "recurrent" if two or more pedestrian-vehicle crashes occurred at or within 0.03 miles of the milepost. If a series of crashes occurred along a corridor, the length of the "crash interval" was not allowed to exceed 0.05 miles. The CDDS typically indicated the whereabouts of the "0.1-mile" sites within the crash record. Milepost-route number sites were identified by referring to street maps, UDOT's *Traffic on Utah's Highways* publications, which indicates the mileposts of selected highway crossings, and UDOT's *Highway Reference Book*. Intermediate crossings and intersections were estimated by scaling off the appropriate distances on street maps. This process was used to pinpoint the locations of pedestrian-vehicle crash sites.

A number of "two-way" recurrent crash sites were identified, in which crashes occurred on both of the intersecting streets at a crossing. All but one of these "two-way" sites were in Salt Lake County – the stray site was located in Utah County. The research team admits to not thoroughly considering the possibilities for two-way crash sites. That is, a few of these sites may have gone unidentified, particularly those at which a single-crash site intersected with another single-crash site. The two-way crash site identification process was oriented toward sites that witnessed two or more crashes on at least one of the intersecting streets.

### Development of a Sample of Multiple-Crash Sites

Of the 6,610 sites at which a pedestrian-vehicle crash occurred between 1992 and 2001 in Utah, 1,090 witnessed multiple (two or more) crashes. These multiple-crash sites were considered, by the research team, to be of greatest concern, the indication being that pedestrian-vehicle incidents were a recurring problem at these locations. It was recognized that all 1,090 sites could not be examined. To facilitate the development of an effective sample, the sites were classified according to the number of crashes occurring during the ten-year study period. As indicated in Table 3, there were 613 two-crash, 215 three-crash, 116 four-crash, 59 five-crash, 34 six-crash, 22 seven-crash, 6 eight-crash, 11 nine-crash, 4 eleven-crash, 3 twelve-crash, 3 thirteen-crash, 1 fourteen-crash, 1 fifteen-crash, 1 sixteen-crash, and 1 nineteen-crash sites. Thus, there were 15 different categories of recurrent pedestrian-vehicle crash sites.

To develop an effective sample of these crash sites, the average annual daily traffic volume (AADT) at each was considered. It is recognized that each AADT changed during the study period; the AADT at each site was considered to be static, however, for the purpose of the sample size determination. The mean AADT for each of the 15 groups of multiple-crash sites was computed; the standard deviation was also computed. The objective was to estimate the mean AADT at each group of sites to a  $\pm 20\%$  level of precision with 95% confidence (a 20% level of precision produced reasonable sample sizes; higher levels of precision were associated with impractically large sample sizes). The sample size for each of the 15 groups of sites was calculated using the following equation:

$$N = [(Z_{\alpha/2}\sigma)/d]^2, \text{ where} \quad [1]$$

- $N$  = desired sample size,
- $Z_{\alpha/2}$  = standard normal variate at a confidence level of  $(1-\alpha)$ ,
- $\sigma$  = standard deviation of the population, and
- $d$  = level of precision.

As stated above, the level of confidence is 95%, so  $\alpha = 0.05$  and  $Z_{\alpha/2} = Z_{0.025} = 1.96$ . Also,  $d$  is 20% of the population mean value  $\mu$ . The sample size calculations are summarized in Table 4. There were too few sites with eight or more crashes for the procedure to be effective; all of these sites, therefore, were included in the sample. Note that the populations do not match those listed in Table 3. This is because some crash sites were “two-way,” in that pedestrians were struck on all of the approaches to the given intersection. At all other sites, pedestrians were struck only while crossing the major street. For the sample size determination, “two-way” crash sites were split into “one-way” sites so that the AADT on each crossing street at an intersection could be incorporated into the analysis.

Column six of Table 4 shows that 169 of the 1,090 multiple-crash sites in Utah (15.5% of the sites) are included in the sample. The next challenge was to select the sites. A “random” sample was considered by the research team to be inappropriate, given the difficulty of choosing a truly random set of crash sites. Further, the importance of the research mandated an educated crash site selection process. To facilitate the selection, a crash severity score was developed. Sites having the highest scores were eligible for inclusion in the sample. The score was based on the medical outcome of each crash, as stated in the Police Accident Report (PAR) and recorded in the CDDS. The scores were based on the cost associated with each outcome, as estimated in a 1994 technical advisory (FHWA 1994). The following figures were proposed as a combination of property damage, medical, lost earnings, lost household production, emergency services, travel delay, vocational rehabilitation, workplace costs, administrative, legal, pain, and lost quality of life. The injury categories were based on the K-B-B-C scale – the analogous CDDS categories are provided in parentheses, along with the average cost associated with each:

- Fatality (fatality) -- \$2,600,000
- Incapacitating (broken bones or bleeding wounds) -- \$180,000
- Evident (bruises and abrasions) -- \$36,000
- Possible (possible injury) -- \$19,000
- Property damage only (no injury) -- \$2,000

These costs were rounded to the nearest “tens” unit to simplify the scores. The following scores were produced. As indicated, one fatal crash is ten times as costly as a crash resulting in broken bones or bleeding wounds:

- No injury: 0.1
- Possible injury: 1
- Bruises and abrasions: 10
- Broken bones or bleeding wounds: 100
- Fatality: 1,000

The 169 crash sites selected for the sample are summarized in Tables 5 (two-crash sites), 6 (three-crash sites), 7 (four-crash sites), 8 (five-crash sites), 9 (six-crash sites), 10 (seven-crash sites), and 11 (eight or more crashes per site). In each table, the “year” is that during which the most recent pedestrian-vehicle incident occurred. The selected sites include those with the highest crash severity scores within the given category. For example, in the set of two-crash sites (Table 5), the 47 sites listed had the highest crash severity scores of all 613 two-crash sites. All 47 of the sites experienced at least one fatality; each of these sites has a score of greater than 1,000. The sampled sites are distributed among 13 of Utah’s 29 counties, including all six urban counties. (Note: An urban county features an agglomeration of 50,000 persons or more at a population density of 1,000 or more per square mile; a small urban county features an urbanized area of 5,000 to 50,000 population; a rural county features no developed areas with populations in excess of 5,000). A summary of the sampled crash sites by county is shown below in Table 4.

**Table 4. Pedestrian-Vehicle Crash Site Sample Size Determination**

Crashes	Population of Sites	Mean AADT ( $\mu$ )	Standard Deviation ( $\sigma$ )	20% Precision (d)	Sample Size (N)
2	634	19,407.6	13,436.0	3,881.5	47
3	244	21,409.1	10,680.9	4,281.8	24
4	127	23,785.9	10,165.0	4,757.2	18
5	68	27,182.0	10,268.6	5,436.4	14
6	34	24,491.7	10,707.4	4,898.3	19
7	22	28,634.5	11,381.1	5,726.9	16
8	<i>Procedure not applicable – too few sites; all sites included in sample</i>				6
9					11
11					3
12					4
13					3
14					1
15					1
16					1
19					1
Total					169

NOTE: Sites for which an AADT value of “1” was recorded were removed from the sample size determination calculations. There were 54 two-crash, four three-crash, one four-crash, one five-crash, and one six-crash sites for which the AADT = 1.

Urban Counties (161 sites)

- Cache – 3
- Davis – 8
- Salt Lake – 111
- Utah – 16
- Washington – 1
- Weber – 22

Small Urban Counties (7 sites)

- Box Elder – 4
- Iron – 1
- Tooele – 2

Rural Counties (1 site)

- Sanpete – 1

The recognition that pedestrian safety is predominantly an urban problem is reflected in the fact that 95.3% of the sites are in urban counties, while 65.7% are in Utah's most urbanized and populous county, Salt Lake. A total of 157 of the sites (92.9%) are in the four counties along the Wasatch Front, excluding Tooele County.

The 1,090 multiple-crash sites in Utah witnessed 3,318 pedestrian-vehicle incidents between 1992 and 2001. This was 37.5% of the 8,838 pedestrian-vehicle incidents experienced at all sites throughout the State. The 169 sites in the sample witnessed 865 pedestrian-vehicle crashes during the study period. The 169 sampled sites, therefore, represented 15.5% of all multiple-crash sites and 2.6% of all crash sites, 26.1% of all crashes occurring at multiple-crash sites and 9.8% of all crashes.

**Table 5. Sampled Recurrent Pedestrian-Vehicle Crash Sites: Two Crashes (1992-2001)**

County	City	Location	Area	Year	AADT	Score
Box Elder	Perry	US 89 0.83 mi south of US 91	Business	2000	10,715	1100.0
Box Elder	?	030240 at milepost 0.59	Residential	1995	1,004	1001.0
Davis	Bountiful	US 89 at 3200 South	Business	1997	14,770	1001.0
Davis	Layton	Main St: midblock 1100 North-1200 North	Shopping	1999	20,105	1100.0
Davis	Layton	Hillfield Rd at 2900 North	Business	2001	20,205	1100.0
Davis	Layton	Main St at Syracuse Rd-Antelope Dr	Shopping	2001	19,125	1010.0
Davis	N. Salt Lake	US 89 at Center St	Business	1994	16,845	1001.0
Salt Lake	Canyon Rim	3300 South at 2940 East	Business	1996	20,550	1010.0
Salt Lake	Kearns	4700 South at Carnegie Tech	Residential	1997	24,965	1100.0
Salt Lake	Kearns	4700 South at Dartmouth Drive (4500 W)	Residential	1997	24,965	1001.0
Salt Lake	Midvale	Husky Hwy at Hillcrest High School	School	1998	32,325	1100.0
Salt Lake	Millcreek	3300 South at Jordan & Salt Lake Canal	Business	1997	20,650	1100.0
Salt Lake	Millcreek	Meadowbrook Exp 0.18 mi w/o 700 West	Residential	1999	30,135	1001.0
Salt Lake	Murray	State St midblock: Creek Dr-6400 South	Business	1997	35,135	1100.0
Salt Lake	Riverton	Redwood Rd at 12900 South	Residential	2000	11,525	1100.0
Salt Lake	Salt Lake City	Redwood Rd 0.5 mi n/o California Av	Industrial	1998	22,155	1100.0
Salt Lake	Salt Lake City	700 East at I-80 eastbound ramps	Business	1998	40,805	1100.0
Salt Lake	Salt Lake City	North Temple at 1460 West	Business	2000	25,090	1100.0
Salt Lake	Salt Lake City	100 South at 1000 East	Residential	2001	10,570	1010.0
Salt Lake	Salt Lake City	600 North at Catherine St (1445 West)	Residential	1996	18,985	1010.0
Salt Lake	Salt Lake City	900 West midblock: 700 North-Diamond Rose Cir	Residential	2000	13,665	1010.0
Salt Lake	Salt Lake City	State St at Kensington Av	Business	1996	31,200	1010.0
Salt Lake	Salt Lake City	300 West at South Temple	Business	1998	29,585	1010.0
Salt Lake	Salt Lake City	N. Temple midblock: 800 West-700 West	Shopping	1995	27,940	1010.0
Salt Lake	Sandy	9400 South at Poppy Lane (945 East)	Business	1996	26,940	1001.0
Salt Lake	S. Salt Lake	3300 South at 300 West	Industrial	2001	43,245	1001.0
Salt Lake	Taylorsville	3200 West at 5620 South	Residential	1993	10,260	1010.0
Salt Lake	Taylorsville	Bangerter Highway 0.1 mi n/o 6200 South	Open	1997	30,500	1000.1
Salt Lake	West Jordan	7000 South at 3420 West	Residential	1997	7,580	1010.0
Salt Lake	West Valley	4000 West at Continental Dr (4225 South)	Residential	2001	17,397	1010.0
Salt Lake	West Valley	3500 South at 6800 West	Business	1996	18,895	1100.0
Sanpete	Ephraim	100 North at 300 East	School	1999	3,970	1010.0
Tooele	Grantsville	Main St at Center St	School	2000	4,450	1100.0
Utah	Lehi	Main St at 3 <sup>rd</sup> East	Business	1997	8,130	1100.0
Utah	Provo	300 South at 400 East	Business	1998	18,955	1010.0
Utah	Provo	South State St at 500 South	Business	1992	45,550	1010.0
Utah	Springville	Center St at 400 East	Residential	1998	4,540	1100.0
Weber	Ogden	24 <sup>th</sup> St at Adams Av	Business	1999	10,690	1100.0
Weber	Ogden	Monroe Blvd at 24 <sup>th</sup> St	Business	1996	13,040	1100.0
Weber	Ogden	Wall Av at 4 <sup>th</sup> St	Residential	2001	22,755	1100.0
Weber	Ogden	36 <sup>th</sup> St at Van Buren Av	Residential	1998	13,950	1010.0
Weber	Ogden	Washington Blvd at Ogden River Pkwy	Business	2001	25,115	1001.0
Weber	Ogden	Washington Blvd at 5 <sup>th</sup> St	Residential	2000	28,850	1001.0
Weber	Ogden	Harrison Blvd at 25 <sup>th</sup> St	Residential	1997	38,885	1001.0
Weber	Roy	1900 West at 5071 South	Residential	1999	23,990	2000.0
Weber	South Ogden	Harrison Blvd at 5600 South	Business	2000	22,045	1100.0
Weber	West Haven	Wilson Lane at 1100 West	Open	2000	11,855	1100.0

The crash severity scores in Table 5 represent the highest of all of the two-crash sites. The following severity scores are possible for two-crash sites:

▪ Two fatalities	2000.0
▪ One fatality + one broken bones-bleeding wounds	1100.0
▪ One fatality + one bruises-abrasions	1010.0
▪ One fatality + one possible injury	1001.0
▪ One fatality + one non-injury	1000.1
▪ Two broken bones-bleeding wounds	200.0

The lowest score possible is 0.2 (two non-injury crashes). The cutoff score for the sample was 1,000.1; that is, all 47 sites had one fatality plus one other incident. Similar scoring procedures apply to the other multiple-crash sites. At three-crash sites, for example, the highest *possible* severity score is 3000.0. No site within any category experienced more than two fatal crashes, though. The highest score among the three-crash sites was 2100.0 (two fatal and one broken bones-bleeding wounds crash). The cutoff score was 1011.0, so all of the three-crash sites experienced at least one fatality.

In progressing through the multiple-crash categories, it is evident that the portion of crashes that were severe decreased as the number of crashes increased. At the lone 19-crash site, for example, the severity score was “only” 515.0 – there were no fatalities, and four crashes resulted in broken bones or bleeding wounds. The remaining 15 crashes were each of a lower severity. The indication is that crashes involving low motor vehicle speeds are prevalent at sites with high levels of crash recurrence. The low speeds might be associated with vehicles executing left and right turns.

### Development of a Sample of Single-Crash Sites

Of the 6,610 sites at which a pedestrian-vehicle crash occurred between 1992 and 2001 in Utah, 5,520 witnessed a single crash. Each of Utah’s 29 counties had at least one single-crash site during the ten-year study period. A method similar to that used to determine a sample size of multiple-crash sites was used to determine a sample size of single-crash sites. That is, the number of sites needed to estimate the mean AADT at all 5,520 sites at a 95% level of confidence and  $\pm 20\%$  precision was determined. The mean AADT was 15,672.8, with a standard deviation of 17,857.4 (*the AADT values at single-crash sites were much less “stable” than those at multiple crash sites, as indicated by the high standard deviation relative to the mean*). Using equation [1], the required sample size was estimated to be 125 single-crash sites. To identify the sites, a principle similar to that used to identify multiple-crash sites was used. That is, the 125 sites having the highest crash severity scores were selected for the sample. As shown in Table 2, there were 224 single fatal pedestrian-vehicle crash sites in Utah between 1992 and 2001. The 125 sites in the sample were selected so as to most closely replicate the mean AADT of all 5,520 single-crash sites. The selection method involved ranking the 224 single fatal pedestrian-vehicle crash sites according to their AADTs, and then “pivoting” off the site having an AADT that was closest to the population mean. By establishing a range of 125 sites, with about 62 below and 63 above the “pivot,” a sample was created.

The 125 sites are listed in Table 12. Each of these sites received a severity score of 1,000 points. Twenty-one of Utah’s 29 counties were the “home” to at least one single fatal pedestrian-vehicle crash site. The research team did not endeavor to collect pedestrian facilities data at each of these sites. Limited time and resources prohibited such an effort.

**Table 6. Sampled Recurrent Pedestrian-Vehicle Crash Sites: Three Crashes (1992-2001)**

County	City	Location	Area	Year	AADT	Score
Box Elder	Brigham City	Main St midblock: Forest St-100 South	Business	1994	17,080	1110.0
Box Elder	Tremonton	Main St at Tremont St	Business	1993	6,860	1020.0
Davis	Bountiful	500 West at 400 North	Business	1997	13,305	1110.0
Salt Lake	Kearns	Cougar Ln (4800 West) at Niagara Wy	School	2001	11,200	1110.0
Salt Lake	Midvale	State St midblock: Inglenook Dr-Plum Tree Ln	Business	1998	33,720	1110.0
Salt Lake	Midvale	State St at 7200 South	Business	2001	37,755	1011.0
Salt Lake	Millcreek	700 East at Rowley Dr (4348 South)	Residential	1999	40,990	1200.0
Salt Lake	Murray	State St at 5600 South	Business	1999	31,545	1110.0
Salt Lake	Salt Lake City	700 East at Simpson Av	Business	1999	44,380	2100.0
Salt Lake	Salt Lake City	600 North at 1100 West	Residential	1997	15,400	1200.0
Salt Lake	Salt Lake City	900 West at 700 South	Residential	2000	18,515	1110.0
Salt Lake	Salt Lake City	300 West at 500 North	Residential	1999	22,725	1110.0
Salt Lake	Salt Lake City	South Campus Dr at parking lot entrance adjacent Huntsman Center	School	1997	16,065	1110.0
Salt Lake	Salt Lake City	State St at Cleveland Av	Business	2000	31,200	1101.0
Salt Lake	Salt Lake City	West Temple + South Temple*	Business	1997	40,520	1100.1
Salt Lake	Salt Lake City	1300 East at Wilmington Av	Shopping	2001	42,550	1011.0
Salt Lake	S. Salt Lake	State St at Ford Av	Business	2000	29,685	1110.0
Salt Lake	West Valley	Redwood Rd at 3100 South	Business	2000	37,890	1200.0
Salt Lake	West Valley	3500 South 0.08 mi w/o Bangerter Hwy	Business	1998	39,860	1110.0
Salt Lake	West Valley	Redwood Rd at 3395 South	Business	2000	37,890	1101.0
Utah	American Fork	Main St at 200 West	Residential	2000	22,765	1011.0
Utah	Pleasant Grove	State St at 820 South	Business	2000	21,770	1101.0
Weber	Ogden	Monroe Blvd at Kershaw St	Residential	2000	13,040	1110.0
Weber	Ogden	Monroe Blvd at 27 <sup>th</sup> St	Business	2001	13,040	1101.0

NOTE: An \* indicates that crashes occurred in crossings of both of the intersecting streets. The “AADT” at this site is the sum of the AADTs of the two intersecting streets.

**Table 7. Sampled Recurrent Pedestrian-Vehicle Crash Sites: Four Crashes (1992-2001)**

County	City	Location	Area	Year	AADT	Score
Cache	Logan	1400 North at 200 East	Shopping	2001	16,285	1021.0
Iron	Cedar City	Main St midblock: 200 North-400 North	Business	1998	19,820	1021.0
Salt Lake	Kearns	5400 South midblock: 4580 West-Northwest Av	Residential	1995	25,655	400.0
Salt Lake	Murray	State St at Constitution Dr	Business	1994	35,675	400.0
Salt Lake	S. Salt Lake	State St at Claybourne Av	Business	2001	33,300	1210.0
Salt Lake	Salt Lake City	North Temple at Cornell St	Business	2001	21,990	1201.0
Salt Lake	Salt Lake City	300 West at 300 South	Business	2000	29,585	1111.0
Salt Lake	Salt Lake City	2100 South at 200 East	Business	2001	21,455	1021.0
Salt Lake	Salt Lake City	900 East at 1300 South	Business	2001	15,000	310.0
Salt Lake	Salt Lake City	2100 South at 800 East	Business	1999	25,905	310.0
Salt Lake	Salt Lake City	South Campus Dr midblock: Campus Center Dr loop	School	1996	16,065	1120.0
Salt Lake	Taylorsville	Redwood Rd at 5245 South	Residential	2000	55,240	1021.0
Tooele	Tooele	Main St at 500 North	Business	1994	20,315	400.0
Utah	Orem	State St at 1200 North	Business	2000	38,825	1020.1
Utah	Springville	Main St at 200 South	Business	2001	17,085	2020.0
Washington	St. George	St. George Blvd at Main St	Business	2000	33,735	1011.1
Weber	Ogden	Washington Blvd midblock: 25 <sup>th</sup> St-26 <sup>th</sup> St	Business	2001	29,555	1201.0
Weber	South Ogden	Washington Blvd at 38 <sup>th</sup> St	Business	1997	22,615	1111.0

**Table 8. Sampled Recurrent Pedestrian-Vehicle Crash Sites: Five Crashes (1992-2001)**

County	City	Location	Area	Year	AADT	Score
Salt Lake	Kearns	4015 West at Sams Blvd (5295 South)	Shopping	2001	19,999	1112.0
Salt Lake	Magna	3500 South at Centennial Rd	Residential	2000	12,745	410.0
Salt Lake	Millcreek	4500 South at 500 East	Business	1999	35,745	1120.1
Salt Lake	Murray	State St at 5770 South	Business	1999	34,175	1210.1
Salt Lake	S. Salt Lake	State St at Utopia Av	Business	1999	41,180	320.0
Salt Lake	Salt Lake City	North Temple midblock: e/o 1950 West	Business	1998	33,300	2201.0
Salt Lake	Salt Lake City	400 South at Pleasant Ct	Business	2001	20,320	1211.0
Salt Lake	Salt Lake City	Redwood Rd at 500 South	Industrial	2001	22,155	1121.0
Salt Lake	Salt Lake City	North Temple at Main St	Business	2000	25,855	311.0
Salt Lake	Salt Lake City	700 East at 800 South	Residential	2001	42,270	301.1
Salt Lake	West Valley	Redwood Rd at 2320 South-Decker Lake	Business	2000	37,890	2030.0
Utah	Provo	University Av at 100 North	Business	1998	44,175	302.0
Weber	Ogden	12 <sup>th</sup> St at Washington Blvd	Shopping	1999	25,125	1040.0
Weber	Ogden	Washington Blvd at 26 <sup>th</sup> St	Business	2000	29,555	1030.1

**Table 9. Sampled Recurrent Pedestrian-Vehicle Crash Sites: Six Crashes (1992-2001)**

County	City	Location	Area	Year	AADT	Score
Salt Lake	Canyon Rim	Highland Dr + 3300 South*	Business	2000	36,795	1140.0
Salt Lake	Midvale	Center St at Allen St-9 <sup>th</sup> Av	Business	2001	16,210	501.0
Salt Lake	Millcreek	3900 South at 300 East	Business	2001	28,570	202.2
Salt Lake	Salt Lake City	1700 South + 700 East*	School	2001	63,175	1230.0
Salt Lake	Salt Lake City	300 East + 400 South*	Business	1997	38,650	213.0
Salt Lake	Salt Lake City	700 East at 900 South	Residential	1996	42,270	312.0
Salt Lake	Salt Lake City	Main St at Market St (340 South)	Business	1996	15,200	222.0
Salt Lake	Salt Lake City	600 South + 700 East*	Residential	2001	50,083	212.1
Salt Lake	S. Salt Lake	State St at Sunset Av	Business	2000	36,185	1230.0
Salt Lake	West Valley	Redwood Rd at Whitlock Av-Parkway Bl	Business	2001	37,890	411.0
Salt Lake	West Valley	3100 South at 2700 West	Business	2001	10,170	231.0
Salt Lake	West Valley	4000 West + 3500 South*	Business	2001	57,257	231.0
Salt Lake	West Valley	2700 West + 3500 South*	Business	2001	63,505	222.0
Utah	Orem	State St at 400 North	Business	2000	47,570	303.0
Utah	Orem	Center St at 400 West	Business	2001	17,875	240.0
Utah	Provo	University Av at University Pkwy	School	2001	34,440	1140.0
Utah	Provo	200 West at 1230 North	Business	2001	17,515	1032.0
Utah	Spanish Fork	Main St at 200 North	Business	2000	23,150	211.0
Weber	Ogden	Wall Av at DMV access n/o 25 <sup>th</sup> St	Business	1999	31,630	1221.0

NOTE: An \* indicates that crashes occurred in crossings of both of the intersecting streets. The "AADT" at this site is the sum of the AADTs of the two intersecting streets.

**Table 10. Sampled Recurrent Pedestrian-Vehicle Crash Sites: Seven Crashes (1992-2001)**

County	City	Location	Area	Year	AADT	Score
Cache	Logan	Main St at 100 South	Business	2001	27,020	1150.0
Cache	Logan	Main St at 400 North	Shopping	2000	31,405	304.0
Salt Lake	Murray	State St + 4500 South*	Business	2000	66,860	412.0
Salt Lake	Murray	Vine St + State St*	Business	2001	34,303	321.1
Salt Lake	Salt Lake City	400 South at Main St	Business	1999	25,770	322.0
Salt Lake	Salt Lake City	200 East + 200 South*	Business	2001	30,865	331.0
Salt Lake	Salt Lake City	2700 South + 700 East*	Business	1998	53,625	250.0
Salt Lake	Salt Lake City	300 West at 400 South	Business	2001	20,320	241.0
Salt Lake	Salt Lake City	200 South at Rio Grande St (440 West)	Church	1999	7,175	232.0
Salt Lake	Salt Lake City	State St at 100 South	Business	2001	32,235	1321.0
Salt Lake	Salt Lake City	State St at Westminster Av	Business	1999	31,375	142.0
Salt Lake	Taylorsville	Redwood Rd at Murray-Taylorsville Rd	Business	1999	55,240	421.0
Utah	Orem	State St at Center St	Business	2000	47,570	232.0
Weber	Ogden	12 <sup>th</sup> St midblock: Grant St-Washington Bl	Business	2001	25,125	1411.0
Weber	Ogden	Washington Blvd at 27 <sup>th</sup> St	Business	1998	29,555	1042.0
Weber	Ogden	Wall Av at 27 <sup>th</sup> St	Business	2000	31,630	421.0

**Table 11. Sampled Recurrent Pedestrian-Vehicle Crash Sites: Eight or More Crashes (1992-2001)**

County	City	Location ( <i>Number of Crashes</i> )	Area	Year	AADT	Score
Davis	Layton	Main St at Church St (12)	Business	2001	21,475	552.0
Davis	Layton	Main St at 1120 North (9)	Business	2001	20,105	530.1
Salt Lake	Canyon Rim	3300 South + 2300 East* (9)	Business	2001	34,275	171.0
Salt Lake	Kearns	4000 West + 4700 South* (15)	Shopping	2000	44,964	176.1
Salt Lake	Millcreek	700 East + 3300 South* (13)	Business	2000	67,430	2162.1
Salt Lake	Millcreek	3900 South + State St* (9)	Business	2000	58,255	1431.0
Salt Lake	Millcreek	State St + 3300 South* (11)	Business	2001	61,865	1253.0
Salt Lake	Millcreek	Main St + 3300 South* (11)	Business	2001	55,355	362.0
Salt Lake	Millcreek	300 East + 3300 South* (13)	Business	2001	42,280	337.0
Salt Lake	Millcreek	3300 South + 1300 East* (8)	Business	2001	39,310	224.0
Salt Lake	Millcreek	900 East + 3300 South* (12)	Business	2001	32,325	172.2
Salt Lake	Salt Lake City	900 South + State St* (8)	Business	1999	36,635	2132.0
Salt Lake	Salt Lake City	1300 South + State St* (12)	Business	2001	49,520	1560.0
Salt Lake	Salt Lake City	State St + 400 South* (14)	Business	2000	60,785	1445.0
Salt Lake	Salt Lake City	State St at Exchange Pl (16)	Business	2001	32,235	753.1
Salt Lake	Salt Lake City	900 West + Indiana Av (800 South)* (11)	Business	2001	29,440	541.1
Salt Lake	Salt Lake City	300 South + State St* (9)	Business	2001	43,457	422.1
Salt Lake	Salt Lake City	200 South + West Temple* (13)	Business	2001	39,020	265.0
Salt Lake	Salt Lake City	900 West + North Temple* (9)	Shopping	2001	42,105	252.0
Salt Lake	Salt Lake City	300 South + West Temple* (9)	Business	2001	43,642	232.2
Salt Lake	Salt Lake City	South Temple + State St* (9)	Business	2001	46,235	162.0
Salt Lake	Salt Lake City	200 South + State St* (9)	Business	2001	48,510	144.0
Salt Lake	Salt Lake City	2100 South + 700 East* (8)	Business	2001	74,920	62.0
Salt Lake	Salt Lake City	Highland Dr-1100 East + 2100 South* (8)	Shopping	2001	37,605	61.1
Salt Lake	Sandy	State St + 9000 South* (9)	Business	2001	46,880	251.1
Salt Lake	Taylorsville	Redwood Rd + 4100 South* (19)	Business	2001	66,675	515.0
Salt Lake	Taylorsville	Redwood Rd at 4200 South-MantleAv (8)	Business	2001	39,910	143.0
Salt Lake	West Valley	3500 South at Redwood Rd (12)	Business	2001	41,625	570.0
Utah	Orem	State St + 1300 South* (9)	Shopping	2000	84,780	333.0
Weber	Ogden	Washington Blvd at 25 <sup>th</sup> St (8)	Business	2001	29,555	134.0
Weber	Roy	5500 South at 4100 West (9)	Business	2001	23,385	333.0

NOTE: \* = crashes occurred in crossings of both of the intersecting streets. The sum of two AADTs is presented.

**Table 12. Sampled Pedestrian-Vehicle Crash Sites: Single Fatal Crash (1992-2001)**

County	City	Location	Area	Year	AADT	Score
Box Elder	Brigham City	Main St at 100 South	Business	1994	17,080	1000.0
Box Elder	Tremonton	I-84 0.54 mi s/o SR 102 interchange	Farms	1992	5,965	1000.0
Box Elder	rural	1200 North at 7600 West? 2300 West?	Residential	1999	2,010	1000.0
Box Elder	rural	US 89 250 ft n/o 200 North (MP 366.69)	Residential	1994	10,400	1000.0
Box Elder	rural	US 89 2.25 mi n/o SR 126	Business	1994	10,400	1000.0
Cache	Hyrum	300 North at 500 West	Residential	1994	3,315	1000.0
Cache	Nibley	Main St at 2900 South	Residential	1996	10,995	1000.0
Cache	North Logan	US 91 0.3 mi s/o 2500 North	Business	1999	25,830	1000.0
Cache	unincorporated	SR 61 2.81 mi w/o US 91	Farms	1999	1,890	1000.0
Cache	unincorporated	US 91 2.19 mi n/o SR 101	Farms	1997	13,275	1000.0
Carbon	Price	100 North at 200 East	Business	1993	12,770	1000.0
Davis	Bountiful	Main Street at 200 West & 1500 South	Residential	2000	11,090	1000.0
Davis	Bountiful	1500 South 0.06 mi e/o 500 West (US 89)	Residential	1992	5,250	1000.0
Davis	Bountiful	500 West at 1500 South	Business	1997	18,220	1000.0
Davis	Clearfield	1000 East at Airplane Dr	School	1999	12,371	1000.0
Davis	Clearfield	State St at Ross Dr	Business	1995	25,425	1000.0
Davis	Clearfield	State St at Clearfield Mobile Home Park	Business	1995	25,425	1000.0
Davis	Clearfield	700 South 0.06 mi e/o State St	Business	1999	22,690	1000.0
Davis	Clearfield	1000 West at 1356 South	Residential	1994	3,980	1000.0
Davis	Farmington	US 89 exit at I-15	Open Land	1997	34,245	1000.0
Davis	Farmington	US 89 at SR 273 ( <i>old at-grade intersect</i> )	Business	1998	27,275	1000.0
Davis	Farmington	SR 106 at MP 10.14	Residential	1999	4,980	1000.0
Davis	Fruit Heights	US 89 at Mountain Rd ( <i>old intersection</i> )	Open Land	1999	27,275	1000.0
Davis	Kaysville	Flint St 0.24 mi n/o 200 North	Residential	2001	3,345	1000.0
Davis	Kaysville	200 North at railroad xing w/o I-15	Railroad	1994	4,155	1000.0
Davis	Layton	US 89 at Sunset Dr (2500 North)	Industrial	1994	25,210	1000.0
Davis	Layton	Main St midblock: 1100 North-1120 North	Business	1995	20,105	1000.0
Davis	Layton	Main St midblock: Reid Dr-1600 North	Business	1992	18,815	1000.0
Davis	Layton	Hillfield Rd at 1550 North	Business	1992	17,530	1000.0
Davis	Layton	Hillfield Rd at Ridgewood Estates MHP	Residential	1996	20,205	1000.0
Davis	N. Salt Lake	US 89 at Main St	Residential	1994	18,960	1000.0
Davis	N. Salt Lake	US 89 at Cloverdale Dr	Residential	2001	14,770	1000.0
Davis	Sunset	Main St 0.07 mi s/o 1300 North	Business	2001	21,360	1000.0
Duchesne	Roosevelt	200 North at 100 West	Residential	1993	2,050	1000.0
Emery	Green River	Main St midblock: Clark St-Solomon St	Business	1995	4,580	1000.0
Emery	rural	I-70 3.14 mi w/o US 6/US 191 interchange	Open Land	1996	3,470	1000.0
Iron	Cedar City	Airport Rd 0.49 mi n/o SR 56	Industrial	1994	2,110	1000.0
Iron	rural	I-15 2.44 mi n/o of Iron County line	Open Land	1992	9,885	1000.0
Iron	rural	I-15 1.23 mi n/o Paragonah interchange	Open Land	2001	10,775	1000.0
Millard	rural	I-15 0.87 mi s/o Meadow interchange	Farms	1997	8,040	1000.0
Salt Lake	East Millcreek	I-80 0.08 mi e/o Foothill Dr off-ramp	Business	1997	25,167	1000.0
Salt Lake	Granite	Wasatch Bl at private drive 0.36 mi n/o SR 209	Business	2000	9,770	1000.0
Salt Lake	Kearns	5400 South midblock: 5160 West-Nez Perce Dr	Residential	1998	26,610	1000.0
Salt Lake	Kearns	5600 West midblock: Henley Dr-Trident Dr	Residential	1995	15,750	1000.0
Salt Lake	Little Cottonwood Creek Valley	Highland Dr 0.03 mi n/o 8150 South-Little Cottonwood Creek Rd	Residential	2000	21,925	1000.0
Salt Lake	Magna	8400 West 0.07 mi n/o 4100 South	Open Land	1998	13,000	1000.0
Salt Lake	Midvale	7200 South at Jordan & Salt Lake Canal	Residential	1994	20,335	1000.0
Salt Lake	Midvale	Husky Hwy at Casa Negra Av (7510 South)	Residential	1998	32,325	1000.0

**Table 12. Sampled Pedestrian-Vehicle Crash Sites: Single Fatal Crash (1992-2001) (continued)**

County	City	Location	Area	Year	AADT	Score
Salt Lake	Midvale	W. Center St at Jordan River Parkway	Residential	1998	31,815	1000.0
Salt Lake	Millcreek	1300 East at Oros Av	Business	1995	14,970	1000.0
Salt Lake	Millcreek	3900 South midblock: 1215 East-1300 East	Business	2000	23,660	1000.0
Salt Lake	Millcreek	900 East at 4500 South (SR 266)	Residential	2000	32,150	1000.0
Salt Lake	Murray	5600 South midblock: Spring Tree Ln-Vine St	Residential	2001	17,445	1000.0
Salt Lake	Murray	700 West at Vine St	Residential	1994	22,470	1000.0
Salt Lake	Murray	Vine St 0.04 mi s/o 5300 South	Residential	1995	15,760	1000.0
Salt Lake	Riverton	2700 West at 8870 South	Residential	1992	11,445	1000.0
Salt Lake	Salt Lake City	100 South at 600 East	Residential	1997	10,370	1000.0
Salt Lake	Salt Lake City	1300 East at 3205 South	Shopping	1996	18,660	1000.0
Salt Lake	Salt Lake City	1500 East at Yale Av-1080 South	Residential	1999	5,611	1000.0
Salt Lake	Salt Lake City	2100 South frontage & Pioneer Rd	Industrial	2001	11,985	1000.0
Salt Lake	Salt Lake City	2 <sup>nd</sup> Av midblock: Canyon Rd-A St	Church	1992	14,385	1000.0
Salt Lake	Salt Lake City	2200 West 0.15 mi s/o 2200 North	Residential	1998	3,928	1000.0
Salt Lake	Salt Lake City	300 South midblock: 640 East-700 East	Residential	1992	10,627	1000.0
Salt Lake	Salt Lake City	300 West 0.05 mi n/o Hartwell Av	Industrial	1993	18,380	1000.0
Salt Lake	Salt Lake City	600 North at 400 West	Industrial	1992	29,250	1000.0
Salt Lake	Salt Lake City	900 West midblock: 700 North-800 North	Business	1994	13,315	1000.0
Salt Lake	Salt Lake City	California Av 0.3 mi w/o Redwood Rd	Industrial	1996	18,030	1000.0
Salt Lake	Salt Lake City	I-80 1.33 mi w/o 7200 West interchange	Open Land	1998	16,350	1000.0
Salt Lake	Salt Lake City	North Temple at 1950 West	Business	1995	32,175	1000.0
Salt Lake	Salt Lake City	North Temple midblock: 600 West-700 West	Business	1996	28,980	1000.0
Salt Lake	Salt Lake City	Redwood Rd midblock: Dalton Av-900 South	Industrial	1998	22,155	1000.0
Salt Lake	Salt Lake City	State St at Belmont Av	School	1994	32,220	1000.0
Salt Lake	Salt Lake City	Wasatch Dr 0.05 mi s/o Michigan Av	Residential	2000	2,300	1000.0
Salt Lake	Sandy	1300 East at 10020 South	Residential	1992	29,435	1000.0
Salt Lake	Sandy	225 West at 9155 South	Business	1997	6,210	1000.0
Salt Lake	Sandy	State St midblock: 10000 South-Alta View Wy & Beetdigger Bl	Business	1992	21,745	1000.0
Salt Lake	South Jordan	Redwood Rd at 9400 South	Business	1993	15,520	1000.0
Salt Lake	Taylorsville	6200 South at Sternwood Dr	School	1992	19,555	1000.0
Salt Lake	West Jordan	Redwood Rd 0.48 mi n/o 7000 South	Business	1995	29,995	1000.0
Salt Lake	West Valley	3100 South at Valley Crest ES	School	1996	3,600	1000.0
Salt Lake	West Valley	3200 West at 4400 South	Residential	1992	11,960	1000.0
Salt Lake	West Valley	3500 South at 4200 West	Residential	1998	25,205	1000.0
Salt Lake	West Valley	5600 West at 2100 South frontage (south)	Industrial	1994	22,900	1000.0
Salt Lake	West Valley	Redwood Rd at 2560 South	Industrial	1993	36,340	1000.0
Salt Lake	West Valley	Redwood Rd at Redwood Pl	Shopping	2000	36,540	1000.0
Salt Lake	West Valley	SR 201 at Bonneville Raceway	Open Land	2000	25,800	1000.0
Sanpete	Ephraim	100 North at 300 East	School	1999	3,970	1000.0
Summit	Rural	I-80 1.76 mi e/o Ranch exit	Open Land	1992	9,430	1000.0
Summit	Park City	Olympic Pkwy (SR 224) at The Canyons	Residential	1998	16,335	1000.0
Tooele	rural	SR 36 at MP 60.23	Residential	1993	8,735	1000.0
Tooele	Mills Junction	SR 36 0.13 mi s/o SR 138	Business	1996	10,950	1000.0
Tooele	Wendover	Wendover Bl at Wildcat Way (400 East)	Business	1999	11,310	1000.0
Tooele	rural	I-80 16.02 mi w/o Knolls interchange	Open Land	2001	7,255	1000.0
Tooele	rural	I-80 2.62 mi w/o Delle interchange	Open Land	1998	7,790	1000.0
Uintah	rural	US 40 0.84 mi w/o road to Fort Duchesne	Open Land	1994	5,340	1000.0
Uintah	Maeser	SR 121 at 500 North	Business	1993	2,735	1000.0
Utah	American Fork	State St at 900 West	Residential	1993	8,335	1000.0
Utah	Orem	800 East at 100 North-Cascade ES	Residential	1995	7,115	1000.0

**Table 12. Sampled Pedestrian-Vehicle Crash Sites: Single Fatal Crash (1992-2001) (continued)**

County	City	Location	Area	Year	AADT	Score
Utah	Orem	Geneva Rd at 960 North	Industrial	1997	9,790	1000.0
Utah	Payson	SR 198 0.18 n/o city limit (MP 3.88)	Business	1998	5,000	1000.0
Utah	Provo	900 East at 150 South	Residential	1997	12,375	1000.0
Utah	Provo	State St at 1140 South	Business	1996	17,230	1000.0
Utah	Provo	300 South midblock: 300 East-400 East	Residential	1997	18,955	1000.0
Utah	Provo	500 West at Center St	Business	1996	31,495	1000.0
Utah	Provo	University Av 1.00 mi s/o 500 South	Shopping	1999	28,700	1000.0
Utah	Springville	400 North at 300 East	Residential	1997	2,219	1000.0
Utah	Springville	Main St midblock: 200 South-300 South	Business	2001	17,085	1000.0
Utah	unincorporated	US 6 3.58 mi e/o Sheep Creek Rd	Open Land	1998	5,775	1000.0
Wasatch	Heber City	Main St 0.125 mi n/o 500 North	Business	1995	8,855	1000.0
Washington	Hurricane	SR 9 midblock: 200 North-300 North	Residential	1992	8,125	1000.0
Washington	St. George	Bluff St at 900 South	Business	2001	17,355	1000.0
Washington	unincorporated	SR 9 0.85 mi w/o Rockville city limit	Open Land	1995	3,060	1000.0
Washington	unincorporated	I-15 1.21 mi n/o Toquerville interchange	Open Land	1999	11,935	1000.0
Weber	Ogden	Grant Av at 29 <sup>th</sup> St	Residential	1994	5,625	1000.0
Weber	Ogden	Monroe Av at Ogden River Parkway	Residential	1996	12,565	1000.0
Weber	Ogden	12 <sup>th</sup> South at Orchard Av	Residential	1998	16,800	1000.0
Weber	Ogden	30 <sup>th</sup> South at Adams Av	Residential	1992	11,185	1000.0
Weber	Ogden	Washington Bl midblock: 35 <sup>th</sup> South-36 <sup>th</sup> South	Business	1997	21,630	1000.0
Weber	Ogden	Harrisville Rd at Dan St	Residential	2000	22,320	1000.0
Weber	Ogden	Harrison Blvd 0.2 mi n/o 20 <sup>th</sup> South	Open Land	1995	31,005	1000.0
Weber	Ogden	Wall Av at 36 <sup>th</sup> South	Business	1992	27,605	1000.0
Weber	Ogden	Wall Av at 33 <sup>rd</sup> South	Business	1993	27,335	1000.0
Weber	Ogden	Wall Av at 28 <sup>th</sup> South	Industrial	1995	29,000	1000.0
Weber	Ogden	Wall Av at Ogden River Parkway	Business	1997	28,320	1000.0
Weber	West Haven	4000 South at 4550 West	Residential	1998	1,825	1000.0
Weber	West Weber	1150 South at 5100 West	Residential	1997	4,095	1000.0
Weber	West Weber	4700 West at N. Branch West Weber Canal	Farms	2001	1,850	1000.0

With the addition of the 125 single fatal crash sites, the database of sampled sites expands to 294, distributed among Utah's counties as follows:

Urban Counties (263 sites)

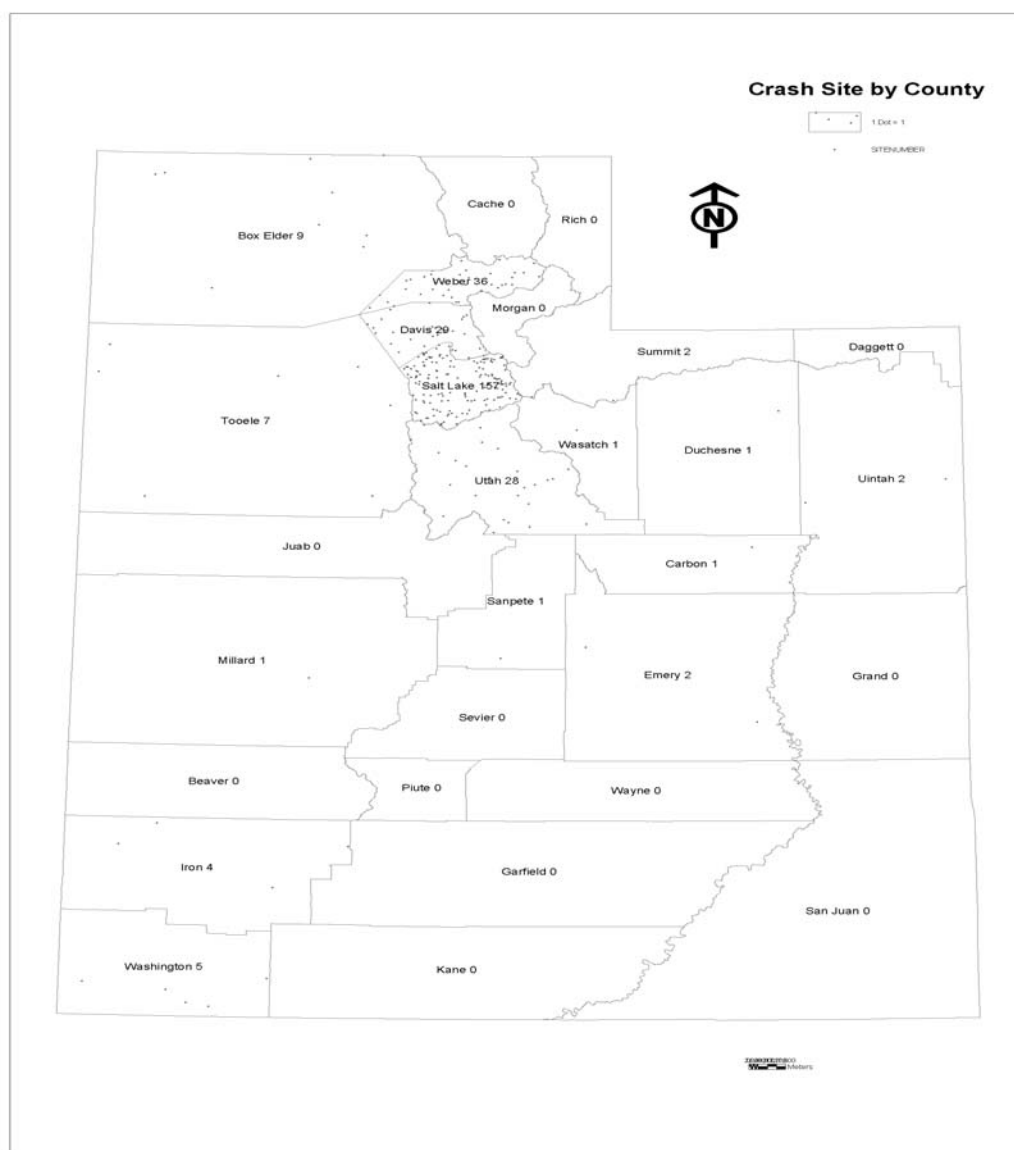
- Cache – 8
- Davis – 29
- Salt Lake – 157
- Utah – 28
- Washington – 5
- Weber – 36

Small Urban Counties (26 sites)

- Box Elder – 9
- Carbon – 1
- Iron – 4
- Summit – 2
- Tooele – 7
- Uintah – 2

- Wasatch – 1
- Rural Counties (5 sites)
- Duchesne – 1
  - Emery – 2
  - Millard – 1
  - Sanpete – 1

Further details on the pedestrian-vehicle crash sites are presented in Chapter 5. Figure 2 displays the approximate statewide distribution of the sampled crash sites.



**Figure 2. General Locations of Sampled Pedestrian-Vehicle Crash Sites**

## CHAPTER 4. Discussion of Crash Data Accuracy and Precision

The research team depended on the CDDS for information about the pedestrian-vehicle collision sites. The data in the CDDS are transcribed from the information provided on Police Accident Reports (PARs). Hard copies of PARs are retained by UDOT; the CDDS represents a convenient compilation of the PARs. The information in the CDDS represents, therefore, the end result of a two-step process. The first involves the on-the-scene recording of crash information, which may involve sketches of the site, an examination of crash debris, an interview of the driver involved, interviews of witnesses, an interview of the pedestrian involved if the person is not severely or fatally injured, and other relevant information. AECOM et al. (undated) noted that police officers will often attempt to determine the cause of a crash. Multi-factorial crashes, however, may not be completely dissected. Injury assessments by police officers are usually made visually; sometimes the injury reported may not correspond with that diagnosed later by a medical examiner.

The second step in the process involves a transfer by a UDOT safety specialist of the information from the PAR into the CDDS. One of the key modifications that the specialist might make is to give the incident a more precise location than is recorded on the PAR. Errors can occur during this modification, since the officer would have been most familiar with the crash location, but may not have given the location a precise milepost or coordinate. In fact, officers commonly use the nearest intersection, street address, or even a landmark as a reference point. The safety specialist, therefore, must attempt to match the officer's description with a milepost or coordinate. Many of the collisions that occur off of the federal-aid highway system are located according to their street addresses, even within the CDDS. This may, at times, be more precise than the mileposts used for the federal-aid system. Mileposts, however, are much more readily accessible to regional and statewide analysis than street addresses.

A number of errors can occur in crash reporting, data transfer, and data encoding. These include (op cit.):

- Recording errors are made by the police officer at the crash scene.
- Crashes may be underreported; for *all* motor vehicle crashes, about 95% of all fatal, 70% of all severe injury, 25% of all moderate injury, and 10% of all minor injury crashes are reported (Elvik and Mysen 1999). The level of underreporting of *pedestrian-vehicle* crashes is not known, although crashes not occurring within public rights-of-way are not recorded in the CDDS at all.
- The police officer makes incorrect assessments of the conditions at the crash scene.
- The officer fails to record certain data from the crash scene.
- The crash location is not recorded correctly by the police officer, including the use of non-standard terminology, misspelled street names, unclear abbreviations, slang, wrong directions, or local landmarks that are not useful for planning and analysis purposes.
- The geocoding process introduces inaccuracies when translating the officer's identification of the crash location to a more useful geographic system, such as mileposts or coordinates.

The research team identified several potential, recurring errors in the CDDS that may affect the accuracy of a crash data analysis. At a number of sites, the AADT was recorded as "1," or the speed limit was "0." It is not readily clear why the actual values were not recorded. An AADT of 1 was typically recorded for crash sites located off of the federal-aid highway system. For these sites, it is probable that traffic volume data did not exist. Regarding the speed limit, it is possible that there was no speed limit sign within view of the crash site. The research team identified multiple-crash sites according to their similar route names and mileposts; crashes occurring at sites located within 0.03 miles of another crash site were also considered to be the same site. In a number of cases, the type of traffic control was not consistent at a site that was otherwise identical. In some of these cases, the traffic control may have changed at the site during the 10-year study period. In other cases, a crossing may have occurred at a signalized intersection, while a crossing immediately upstream or downstream may have been recorded as "no control" or "traffic

lanes marked.” Similar mixtures of site-related statistics occurred with traffic volumes, functional classification, and even land uses. The mixtures were not always related to an obvious progression of change at or near the site.

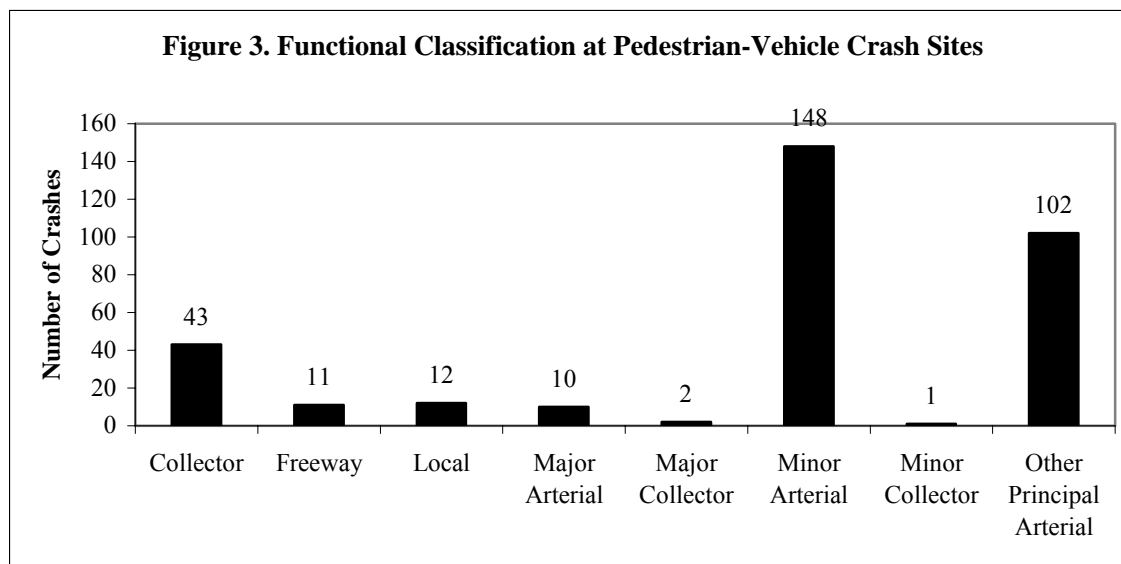
The research team was informed that the statewide highway reference system underwent a major overhaul in 1995. It is possible, then, that the mileposts from pre-1995 do not match those from 1995 and later. In these cases, two crashes identified as occurring at the same site may have actually occurred at different sites. The changes in the reference system were not readily apparent to the research team. It was ascertained by the team that there was no efficient way to segregate sites according to “old milepost” and “new milepost.” Further, there was no efficient method to identify and adjust “old” mileposts such that they would match the new system. The research team, therefore, elected to use the 10-year database in its original form. The extent of inaccuracy or imprecision associated with this decision is unknown. It is recognized that pedestrian-vehicle crashes are relatively infrequent events. It is unusual, for example, for more than one pedestrian-vehicle crash per year to occur at a given site (there were just 14 such sites in Utah). Thus, it was critical to retain the richness of the pedestrian-vehicle crash database and use as much of its information as was available. The removal of data because of suspicions about certain crash locations was not considered. It is suggested, though, that crash data accuracy and precision issues be investigated further. Such a study might produce a level of precision or confidence level that could be applied to all statewide crash data analysis.

## CHAPTER 5. Infrastructure at Pedestrian-Vehicle Crash Sites

The CDDS lists the following motor vehicle-related infrastructure data items for each pedestrian-vehicle crash site: traffic control type, number of lanes, functional classification, and speed limit. No pedestrian facilities are listed. Since the type of traffic control varied within the database from crash to crash, traffic control was considered on a per-crash rather than a per-site basis. This data item is discussed in Chapter 6. The sample size for the infrastructure analysis was 329 rather than 294 sites. The 35 “extra” sites represented the cross streets at intersections at which motor vehicle collisions with pedestrians occurred in crossings of both streets.

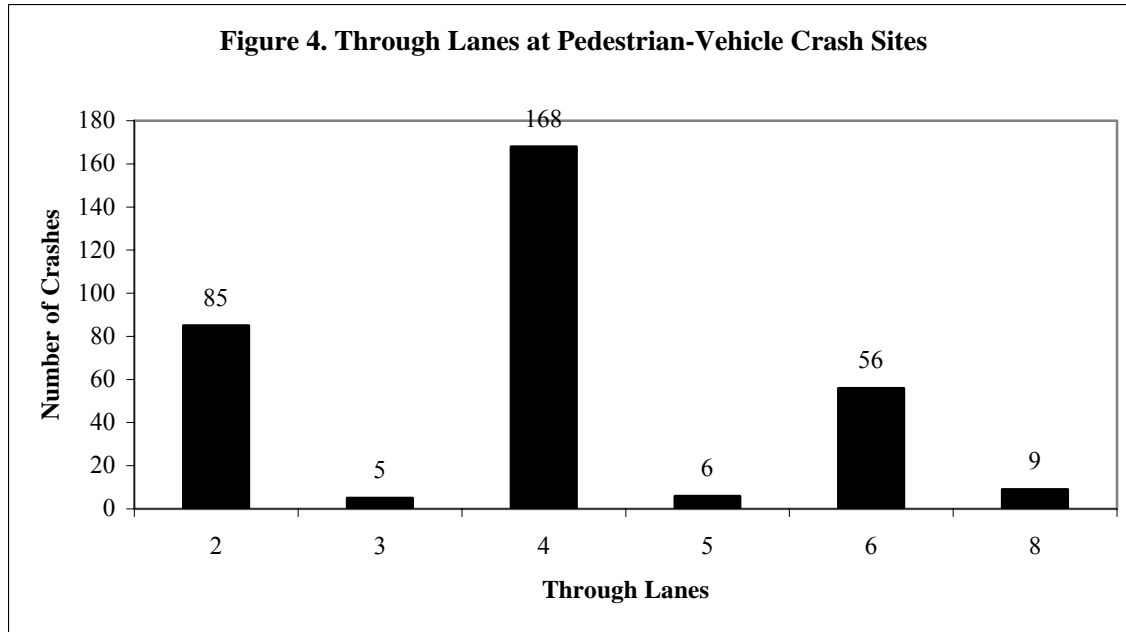
### Functional Classification

Nearly half (148 or 45.0%) of the pedestrian-vehicle incidents in the sample occurred along minor arterials, as shown in Figure 1. An additional 102 (31.0%) occurred on other principal arterials, while 43 (13.1%) occurred on collectors. Of the 36 remaining incidents, 12 occurred on local streets, 11 occurred on interstate freeways, and ten occurred on major arterials (a rural designation). Urban arterials, therefore, were the scene of 76.0% (250) of the collisions. All of the freeway incidents were single fatal crashes. The sample was designed to emphasize high-severity crash sites, so it would be an incorrect to conclude that *all* freeway pedestrian-vehicle collisions are fatal (although a large portion of them probably are). About two-thirds (29) of the collectors intersected with minor or other principal arterials at pedestrian-vehicle crash sites. Similarly, just over half of the local streets (7) intersected with arterials at pedestrian-vehicle crash sites. Many of the crashes at these sites were “attributed” to the arterials.



### Number of Lanes

Just over half (168 or 51.1%) of the pedestrian-vehicle crashes occurred at locations at which there were four through lanes, as presented in Figure 2. It should be noted that the number of lanes recorded in the CDDS is not necessarily the number of lanes that the pedestrian has to cross. The research team observed that, at many sites, there were often one or more turning lanes, along with one or more shoulders (striped or unstriped). The number of lanes in the CDDS, therefore, is not necessarily indicative of the pedestrian

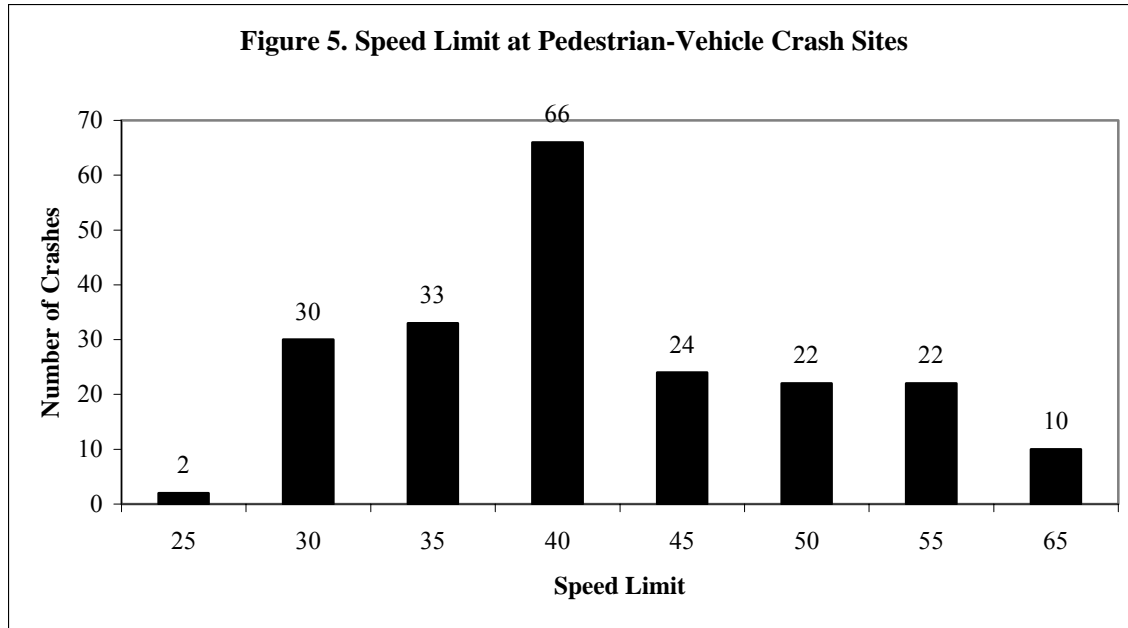


crossing distance. The number of through lanes nonetheless provides a useful, general statistic that can be used to compare sites. Two-lane sites were the next most “popular” pedestrian-vehicle location, with 85 (25.8%) of all sites. A total of 56 (17.0%) of the sites had six through lanes. In reference to the preceding discussion, the research team found that pedestrian crossing distances could be confirmed only through site visits.

### Speed Limit

The speed limits at the pedestrian-vehicle crash sites ranged from 25 to 65 MPH, as shown in Figure 3. The speed limit was not necessarily the *actual speed* of the motor vehicle at the moment of impact, but it is nonetheless a useful guideline. The speed limit at 66 (20.1%) of the crash sites was 40 MPH. The Final Report (the Technical Document – this document – is a companion to the Final Report) identifies 45 MPH as a threshold speed for marked crossings at uncontrolled locations. That is, at speeds (actually, 85<sup>th</sup> percentile speeds) less than 45 MPH, a marked crossing *may* be recommended at an uncontrolled location if other criteria are satisfied. A marked crossing at an uncontrolled location is generally not recommended, though, when the speed is 45 MPH or more. The data indicate that 78 (23.7%) of the pedestrian-vehicle crash sites occurred where the speed limit was 45 MPH or more. A total of 63 of these sites (about 80%) were uncontrolled. The supposition is that these 63 sites would *not* be eligible for marked crossings without the introduction of some form of traffic control (stop sign or traffic signal). A number of interventions might be considered at these locations to prevent further pedestrian-vehicle incidents, such as:

- Grade-separated crossing
- Traffic signal at the location, along with a marked crosswalk
- Stop signs, along with a marked crosswalk
- Pedestrian crossing prohibition (either signing or a physical barrier)
- None (presuming that the collision was an isolated incident, possibly resulting in part from errant pedestrian behavior)



Because of limited resources, the research team was not able to perform field investigations of all 63 of these crash sites. At one of the sites that *was* visited, the research team observed a marked crossing at an uncontrolled location where the speed limit was 45 MPH. The location of this crossing is in contradiction with the example guidelines listed in the Final Report. Further study of this and the other 62 pedestrian-vehicle crash sites is needed. A detailed study of the specific conditions at these sites was beyond the scope of this research.

The research team observed that the speed limit at a number of sites, as observed in the field, was different from that in the CDDS. At the 11 freeway sites, the speed limit at one site was recorded in the CDDS as 55 MPH, while that at the other ten sites was 65 MPH. Each of these speed limits had increased by 10 MPH between the time of the incident and the period of this research.

### Field Visits

To supplement the CDDS, the research team visited about two-thirds of the 294 crash sites in the sample. A complete inventory of information was taken at about 75% of the sites visited. The inventory concentrated on infrastructure that was not described in the CDDS, such as pedestrian facilities, transit stops, lighting, and the crossing width. The inventory also included items reported in the CDDS, such as speed limits and traffic controls. The field inventory data was compared with the CDDS information for either confirmation or modification. The data recorded in the field included:

- Type of traffic control
- Pedestrian signal times, including walking man and flashing hand times
- Speed limit
- Pedestrian crossing facilities (if any)
- Distance to the nearest pedestrian crossing
- Availability of sidewalks and curb ramps
- Adjacent or nearby transit stops
- Number of through and turning lanes
- Number of shoulders and bicycle lanes

- Presence of a raised median
- Adjacent land uses
- Lighting

At the other 25% of the sites, a subset of the preceding information was collected. The emphasis at these sites was on pedestrian crossing facilities, the number of lanes and shoulders, and the type of traffic control. These were “pass-by” sites at which the technician usually did not bother to get out of his or her motor vehicle (although the technician typically stopped briefly to record information). The raw data are provided in the Appendix, which is separate from this document. A summary of the data collected at the visited sites is provided in Table 13. The Appendix features individual data sheets for the sites at which detailed information was collected.

**Table 13. Infrastructure at Pedestrian-Vehicle Crash Sites in Utah – 294 Sampled Sites**

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
American Fork	Main St at 200 West	3	1011.0	2000	Stop None	22,765	PA	4	30	Marked	Bus	41020	Residential	
American Fork	State St at 900 West	1	1000.0	1993	None	8,335	MA	4	40	None	Bus	41000	Residential	No
Bountiful	1500 South 0.06 mi east of 500 West (US 89)	1	1000.0	1992	None	5,250	C	2	30	None 500 W	Bus	20020	Residential	Yes
Bountiful	500 West at 1500 South	1	1000.0	1997	Signal 23 sec	18,220	MA	4	40	Marked	None	41000	Business Shopping	No
Bountiful	500 West at 400 North	3	1110.0	1997	Signal 16 sec	13,305	MA	4	40	Marked	Bus	41000	Business	Yes
Bountiful	Main Street at 650 South	1	1000.0	2000	None	11,090	C	2	30	Marked	Bus	21020	Residential	Yes
Bountiful	US 89 at 3200 South	2	1001.0	1997	None	14,770	MA	4	45	Marked: School	Bus	41020	Shopping Residential	
Box Elder County	030240 at milepost 0.59	2	1001.0	1995	None	1,004	C	2	0				Residential	
Box Elder County	1200 North at 7600 West? 2300 West?	1	1000.0	1999	None	2,010	MC	2	40				Residential	
Box Elder County	US 89 250 ft n/o 200 North (MP 366.69)	1	1000.0	1994	None	10,400	MA	4	55				Residential	No
Box Elder County	US 89 2.25 mi n/o SR 126	1	1000.0	1994	None	10,400	MA	4	55				Business	
Brigham City	Main St at 100 South	1	1000.0	1994	Signal	17,080	PA	4	30	Marked	Bus	41020	Business	Yes
Brigham City	Main St midblock: Forest St-100 South	3	1110.0	1994	None	17,080	PA	4	30	Marked	None	41020	Business	Yes
Cache County	SR 61 2.81 mi west of US 91	1	1000.0	1999	None	1,890	RA	2	55	None	None	20000	Farms	
Cache County	US 91 2.19 mi north of SR 101	1	1000.0	1997	None	13,275	PA	4	55	None	None	41020	Farms	No
Canyon Rim	3300 South + 2300 East*	9	171.0	2001	Signal 30-35	17,075 17,200	PA MA	4 2	40 40	Marked Marked	Bus	32010 32010	Shopping	Yes
Canyon Rim	3300 South at 2940 East	2	1010.0	1996	None	20,550	PA	6	40	Marked	Bus	61000	Business	
Canyon Rim	Highland Dr + 3300 South*	6	1140.0	2000	Signal 57-20	19,530 17,265	MA PA	2 4	40 35	Marked Marked	None	42000 42000	Business	Yes
Cedar City	Airport Rd 0.49 mi north of SR 56	1	1000.0	1994	None	2,110	MA	2	45		None		Industrial	Yes
Cedar City	Main St midblock: 200 North-400 North	4	1021.0	1998	None	19,820	PA	4	45		None		Business	
Clearfield	1000 East at Airplane Dr	1	1000.0	1999	Warning	12,371	L	2	25	None School	None	20000	School	Yes
Clearfield	1000 West at 1356 South	1	1000.0	1994	None	3,980	C	2	35	None 1300 S	None	20020	Residential School	Yes
Clearfield	700 South 0.06 mi east of State St	1	1000.0	1999	None	22,690	MA	4	0	None State St	Bus	41020	Shopping	Yes
Clearfield	State St at Clearfield Mobile Home Park	1	1000.0	1995	None	25,425	MA	4	45	Marked: school	Bus	41000	Shopping	Yes
Clearfield	State St at Ross Dr	1	1000.0	1995	None	25,425	MA	4	45	None 700 S	Bus	41000	Shopping	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
East Millcreek	I-80 0.08 mi east of Foothill Dr off-ramp	1	1000.0	1997	None	25,167	F	4	55	None	None		Business	
Emery County	I-70 3.14 mi west of US 6/US 191 interchange	1	1000.0	1996	None	3,470	F	4	65	None	None	40120	Open Land	No
Ephraim	100 North at 300 East	2	1010.0	1999	None	3,970	MC	4	35				School	
Farmington	SR 106 at MP 10.14	1	1000.0	1999	None	4,980	MA	2	40				Residential	
Farmington	US 89 exit at I-15	1	1000.0	1997	None	34,245	PA	4	55				Open Land	
Farmington	US 89 at SR 273 (old at-grade intersect)	1	1000.0	1998	None	27,275	PA	4	55				Business	
Fruit Heights	US 89 at Mountain Rd (old intersection)	1	1000.0	1999	None	27,275	PA	4	55				Open Land	
Granite	Wasatch Bl at private drive 0.36 mi north of SR 209	1	1000.0	2000	None	9,770	C	2	45	None	None	21020	Business Open	Yes
Grantsville	Main St at Center St	2	1100.0	2000	Officer None	4,450	RA	2 4	35	Zebra: school	Bus	41020	School	Yes
Green River	Main St midblock: Clark St-Solomon St	1	1000.0	1995	None	4,580	RA	4	40				Business	Yes
Heber City	Main St 0.125 mi north of 500 North	1	1000.0	1995	None	8,855	PA	2	45				Business	Yes
Hurricane	SR 9 midblock: 200 North-300 North	1	1000.0	1992	None	8,125	PA	2	40				Residential	
Hyrum	300 North at 500 West	1	1000.0	1994	None	3,315	RA	2	50		None		Residential	Yes
Iron County	I-15 1.23 mi north of Paragonah interchange	1	1000.0	2001	None	10,775	F	4	75	None	None	40120	Open Land	
Iron County	I-15 2.44 mi north of Iron County line	1	1000.0	1992	None	9,885	F	4	65 75	None	None	40120	Open Land	No
Kaysville	200 North at railroad xing west of I-15	1	1000.0	1994	Officer	4,155	MA	2	40	None School	None	20020	Railroad	No
Kaysville	Flint St 0.24 mi north of 200 North	1	1000.0	2001	None	3,345	C	2	30	None Gentile	None	20020	Residential	No
Kearns	4000 West + 4700 South*	15	176.1	2000	None Signal 72-30	19,999 24,965	L PA	2 4	40 35	Marked Marked	None	41020 22000	Shopping Business	Yes
Kearns	4015 West at Sams Blvd (5295 South)	5	1112.0	2001	None	19,999	L	2	0	None 5255 S	None	41000	Shopping Residential School	
Kearns	4700 South at Carnegie Tech	2	1100.0	1997	None	24,965	PA	4	35	None# 4720 W	Bus	31020	Residential	Yes
Kearns	4700 South at Dartmouth Drive (4500 W)	2	1001.0	1997	None Signal 22 sec	24,965	PA	4	35	Marked	Bus	31020	Residential	Yes
Kearns	5400 South midblock: 4580 West-Northwest Av	4	400.0	1995	Signal	25,655	MA	4	40	None Northwest	Bus	41000	Residential	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Kearns	5400 South midblock: 5160 West-Nez Perce Dr	1	1000.0	1998	None	26,610	MA	4	45	None	Bus	41000	Residential	
Kearns	5600 West midblock: Henley Dr-Trident Dr	1	1000.0	1995	None	15,750	PA	2	40		Bus		Residential	
Kearns	Cougar Ln (4800 West) at Niagara Wy	3	1110.0	2001	None <i>Signal 28 sec</i>	11,200	C	2 5	35	Marked	Bus	61000	School	Yes
Layton	Hillfield Rd at 1550 North	1	1000.0	1992	None	17,530	MA	4	40	None 1225 N	Bus	41020	Business	Yes
Layton	Hillfield Rd at 2900 North	2	1100.0	2001	None	20,205	MA	4	45	None 2475 N	Bus	41020	Business	No
Layton	Hillfield Rd at Ridgewood Estates MHP	1	1000.0	1996	None	20,205	MA	4	45	None SR 193	Bus	41020	Residential	
Layton	Main St at 1120 North	9	530.1	2001	None	20,105	MA	4	45	None 1200 W	None	41020	Shopping	Yes
Layton	Main St at Church St	12	552.0	2001	Yield <i>None</i>	21,475	MA	4	40	None Gentile	None	41020	Business	Yes
Layton	Main St at Syracuse Rd-Antelope Dr	2	1010.0	2001	Signal 87 sec	19,125	MA	4	45	Marked	Bus	42020	Shopping	Yes
Layton	Main St at Camelot St	1	1000.0	1992	None	18,815	MA	4	45	None	None	41020	Business	No
Layton	Main St: midblock 1100 North-1120 North	2	1100.0	1999	None	20,105	MA	4	45	None	Bus	41020	Shopping	Yes
Layton	US 89 at Sunset Dr (2500 North)	1	1000.0	1994	None	25,210	PA	4	55	None	Bus	41020	Industrial <i>Residential</i>	No
Lehi	Main St at 3 <sup>rd</sup> East	2	1100.0	1997	None	8,130	PA	2	30 40	None	None	20000	Business <i>Residential</i>	Yes
Little Cottonwood Creek Valley	Highland Dr 0.03 mi north of 8150 South-Little Cottonwood Creek Rd	1	1000.0	2000	None	21,925	PA	2	0	None		41020	Residential	Yes
Logan	1400 North at 200 East	4	1021.0	2001	Signal 36 sec	16,285	MA	4	45 40	Marked	Bus	42010	Shopping	Yes
Logan	Main St at 100 South	7	1150.0	2001	Signal 23 sec	27,020	PA	4	35	Marked	None	42000	Business	
Logan	Main St at 400 North	7	304.0	2000	Signal	31,405	PA	4	35	Marked	Bus		Shopping	
Maeser	SR 121 at 500 North	1	1000.0	1993	None	2,735	MA	2	50				Business	
Magna	3500 South at Centennial Rd	5	410.0	2000	None	12,745	MA	2	45 40	Marked: School	None		Residential	
Magna	8400 West 0.07 mi north of 4100 South	1	1000.0	1998	None	13,000	MA	4	55				Open Land	
Midvale	7200 South at Jordan & Salt Lake Canal	1	1000.0	1994	Other	20,335	MA	2	0		Bus		Residential	
Midvale	Center St at Allen St-9 <sup>th</sup> Av	6	501.0	2001	None <i>Signal 12 sec</i>	16,210	MA	4	35	Marked	Bus	61120	Business Shopping	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Midvale	Husky Hwy at Casa Negra Av (7510 South)	1	1000.0	1998	None <i>Signal 23 sec</i>	32,325	PA	2	45 40	Marked	Bus	61000	Residential	
Midvale	Husky Hwy at Hillcrest High School	2	1100.0	1998	None <i>Signal 17 sec</i>	32,325	PA	2	45	Marked	Bus		School <i>Shopping</i>	
Midvale	State St at 7200 South	3	1011.0	2001	Signal 21 sec	37,755	MA	4	40	Marked	Bus	42000	Business	Yes
Midvale	State St midblock: Inglenook Dr-Plum Tree Ln	3	1110.0	1998	None	33,720	PA	5	40 45	None 7200 S?	Bus	50100	<i>Residential Shopping</i>	No
Midvale	7800 South at Jordan River Parkway	1	1000.0	1998	None	31,815	MA	4	40	None	Bus	41100	Residential	No
Millard County	I-15 0.87 mi south of Meadow interchange	1	1000.0	1997	None	8,040	F	4	75	None	None	<u>40120</u>	Farms	No
Millcreek	1300 East at Oros Av	1	1000.0	1995	None	14,970	MA	2	40				Business	
Millcreek	300 East + 3300 South*	13	337.0	2001	Signal 60-15	10,100 32,180	C PA	2 4	30 35	Marked Marked	Bus	21000 41000	Business	Yes
Millcreek	3300 South + 1300 East*	8	224.0	2001	Signal 20-20	20,650 18,660	PA MA	4 4	35 40	Marked Marked	Bus	42000 32000	Shopping	Yes
Millcreek	3300 South at Jordan & Salt Lake Canal	2	1100.0	1997	None	20,650	PA	4	35	None 1300 E	Bus		Shopping <i>Residential</i>	
Millcreek	3900 South + State St*	9	1431.0	2000	Signal 40-28	28,570 29,685	MA MA	4 6	40 40	Marked Marked	Bus	42010 62010	Shopping	Yes
Millcreek	3900 South at 300 East	6	202.2	2001	Signal	28,570	MA	4	40	Marked	Bus	41000	Business	Yes
Millcreek	3900 South midblock: 1215 East-1300 East	1	1000.0	2000	None	23,660	MA	3	40	None 1300 E		41020	Business	
Millcreek	4500 South at 500 East	5	1120.1	1999	Signal 28 sec*	35,745	PA	6	40	Marked	Bus	61000	Business <i>Residential</i>	Yes
Millcreek	700 East + 3300 South*	13	2162.1	2000	Signal 28	46,340 21,090	PA PA	8 4	45 0	Marked	Bus	81000 41000	Business	Yes
Millcreek	700 East at Rowley Dr (4348 South)	3	1200.0	1999	None	40,990	PA	6	50	None 4500 S	Bus	80000	Residential	
Millcreek	900 East + 3300 South*	12	172.2	2001	Signal 67-19	11,675 20,650	C PA	2 4	40 35	Marked Marked	Bus	42000 42000	Business	Yes
Millcreek	900 East at 4500 South (SR 266)	1	1000.0	2000	None <i>Signal</i>	32,150	PA	6	50	Marked	Bus	31000	Residential <i>Shopping</i>	
Millcreek	Main St + 3300 South*	11	362.0	2001	Signal 47-23	13,110 42,245	C PA	2 6	35 35	Marked Marked	Bus	22010 61000	Business	Yes
Millcreek	Meadowbrook Exp 0.18 mi w/o 700 West	2	1001.0	1999	None	30,135	MA	4	0	None 700 W	Bus	41020	Residential	No
Millcreek	State St + 3300 South*	11	1253.0	2001	Signal 30-22	29,685 32,180	MA PA	6 4	40 0	Marked Marked	Bus	62000 62000	Business	Yes
Mills Junction	SR 36 0.13 mi south of SR 138	1	1000.0	1996	None	10,950	PA	2	55				Business	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Murray	5600 South midblock: Spring Tree Ln-Vine St	1	1000.0	2001	None	17,445	MA	2	30	None		20020	Residential	
Murray	700 West (Glendon St) at Vine St	1	1000.0	1994	None	22,470	MA	2	0 25	None Germania	None	20020	Residential	No
Murray	State St + 4500 South*	7	412.0	2000	Signal ↓	31,115 35,745	MA PA	6 6	40 45	Marked Marked	Bus	51020 42010	Shopping	Yes
Murray	State St at 5600 South	3	1110.0	1999	Signal 21 sec	31,545	MA	6	40 45	Marked	None	61000	Business	Yes
Murray	State St at 5770 South	5	1210.1	1999	None	34,175	PA	6	40 45	None 5600 S	None	61000	Shopping	No
Murray	State St at Constitution Dr	4	400.0	1994	None	35,675	MA	6	35	None Intermntn	Bus	61120	Business Park	Yes
Murray	State St midblock: Creek Dr-6400 South	2	1100.0	1997	None	35,135	PA	6	40	None 6400 S	Bus	30120	Business Shopping	Yes
Murray	Vine St + State St*	7	321.1	2001	Signal 26-35	2,413 31,890	L MA	2 6	30 40	Marked Marked	Bus	62010	Shopping	Yes
Murray	Vine St 0.04 mi south of 5300 South	1	1000.0	1995	None	15,760	MA	2 3	0 30	None 5300 S	Bus	31010	Residential	Yes
Nibley	Main St at 2900 South	1	1000.0	1996	None	10,995	MA	4	0		Bus		Residential	Yes
North Logan	US 91 0.3 mi s/o 2500 North	1	1000.0	1999	None	25,830	PA	4	55	None			Business	
North Salt Lake	US 89 at Center St	2	1001.0	1994	Signal 23 sec	16,845	MA	4	40	Marked	Bus	41000	Business	Yes
North Salt Lake	US 89 at Cloverdale Dr	1	1000.0	2001	None	14,770	MA	4	45	Marked	Bus	41000	Residential	Yes
North Salt Lake	US 89 at Main St	1	1000.0	1994	Other None	18,960	MA	4	45	None Center St	Bus	41000	Residential	Yes
Ogden	12 <sup>th</sup> South at Orchard Av	1	1000.0	1998	None	16,800	PA	2	45	Marked	Bus	41020	Residential	
Ogden	12 <sup>th</sup> St at Washington Blvd	5	1040.0	1999	Signal	25,125	PA	4	40		Bus		Shopping	
Ogden	12 <sup>th</sup> St midblock: Grant St-Washington Bl	7	1411.0	2001	None	25,125	PA	4	40	None US 89	None	41000	Business	Yes
Ogden	24 <sup>th</sup> St at Adams Av	2	1100.0	1999	Signal 19 sec	10,690	MA	4	30 35	Marked	None	41000	Business Church	
Ogden	30 <sup>th</sup> South at Adams Av	1	1000.0	1992	None	11,185	PA	2	35		Bus		Residential	Yes
Ogden	36 <sup>th</sup> St at Van Buren Av	2	1010.0	1998	None	13,950	MA	2	25	None Harrison	Bus	20020	Residential	Yes
Ogden	Grant Av at 29 <sup>th</sup> St	1	1000.0	1994	None	5,625	C	2	0		None		Residential	
Ogden	Harrison Blvd 0.2 mi north of 20 <sup>th</sup> South	1	1000.0	1995	None	31,005	PA	4	0				Open Land	
Ogden	Harrison Blvd at 25 <sup>th</sup> St	2	1001.0	1997	None	38,885	PA	4	40	None 24 <sup>th</sup> St	Bus	41020	Residential	Yes
Ogden	Harrisville Rd at Dan St	1	1000.0	2000	Stop None	22,320	PA	4	50	None	None	41000	Residential	
Ogden	Monroe Av at Ogden River Parkway	1	1000.0	1996	None	12,565	MA	4	0 40	Marked	Bus	41020	Residential	

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Ogden	Monroe Blvd at 24 <sup>th</sup> St	2	1100.0	1996	None Signal 17 sec	13,040	MA	2	35	Marked	None	21020	Business Residential	Yes
Ogden	Monroe Blvd at 27 <sup>th</sup> St	3	1101.0	2001	Stop None	13,040	MA	2	25	None 27 <sup>th</sup> St	Bus	21020	Business	
Ogden	Monroe Blvd at Kershaw St	3	1110.0	2000	Stop	13,040	MA	2	25	None 27 <sup>th</sup> St	Bus	21020	Residential	
Ogden	Wall Av at 27 <sup>th</sup> St	7	421.0	2000	None	31,630	MA	4	40	None	None		Business	
Ogden	Wall Av at 28 <sup>th</sup> South	1	1000.0	1995	None	29,000	MA	4	40	None 29 <sup>th</sup> St	None		Industrial	Yes
Ogden	Wall Av at 33 <sup>rd</sup> South	1	1000.0	1993	None	27,335	MA	4	40	None			Business	Yes
Ogden	Wall Av at 36 <sup>th</sup> South	1	1000.0	1992	None Signal 27 sec	27,605	MA	4	40	Marked	Bus	42020	Shopping	Yes
Ogden	Wall Av at 4 <sup>th</sup> St	2	1100.0	2001	None	22,755	MA	4	40	None	Bus	41000	Residential	Yes
Ogden	Wall Av at DMV access north of 25 <sup>th</sup> St	6	1221.0	1999	Signal None	31,630	MA	4	40	None 25 <sup>th</sup> St	Bus		Business	
Ogden	Wall Av at Ogden River Parkway	1	1000.0	1997	None	28,320	MA	4	40	None	Bus	41000	Business Park	Yes
Ogden	Washington Bl midblock: 35 <sup>th</sup> South-36 <sup>th</sup> South	1	1000.0	1997	None	21,630	PA	4	35 40	None 35 <sup>th</sup> St 36 <sup>th</sup> St	None	41020	Business Shopping	Yes
Ogden	Washington Blvd at 25 <sup>th</sup> St	8	134.0	2001	Signal 28 sec	29,555	PA	6	30	Marked	Bus	51020	Business	Yes
Ogden	Washington Blvd at 26 <sup>th</sup> St	5	1030.1	2000	Signal 20 sec	29,555	PA	4	40 30	Marked	Bus	52010	Business	Yes
Ogden	Washington Blvd at 27 <sup>th</sup> St	7	1042.0	1998	Signal 19 sec	29,555	PA	5	35	Marked	Bus	52010	Business	Yes
Ogden	Washington Blvd at 5 <sup>th</sup> St	2	1001.0	2000	Stop None	28,850	PA	4	40	None 300m	None	61020	Residential Shopping	
Ogden	Washington Blvd at Ogden River Pkwy (River Dr)	2	1001.0	2001	Signal None	25,115	PA	6	30	None	Bus	61020	Shopping Park	
Ogden	Washington Blvd midblock: 25 <sup>th</sup> St-26 <sup>th</sup> St	4	1201.0	2001	None	29,555	PA	6	30	None 25 <sup>th</sup> St 26 <sup>th</sup> St	Bus		Business	
Orem	800 East at 100 North-Cascade ES	1	1000.0	1995	None	7,115	MA	2	0				Residential	No
Orem	Center St at 400 West	6	240.0	2001	Signal 25 sec	17,875	MA	3	35	Marked	None	51000	Business	
Orem	Geneva Rd at 960 North	1	1000.0	1997	None	9,790	MA	2	50	None	None	21000	Industrial	No
Orem	State St + 1300 South*	9	333.0	2000	Signal+ 31-36	45,440 39,340	PA PA	6 4	40 50	Marked Marked	None	63000 43000	Shopping	
Orem	State St at 1200 North	4	1020.1	2000	Signal 34 sec	38,825	PA	6	40	Marked	None	41020	Business	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Orem	State St at 400 North	6	303.0	2000	Signal 32 sec	47,570	PA	6	40	Marked	None	61020	Business	Yes
Orem	State St at Center St	7	232.0	2000	Signal 37 sec	47,570	PA	6	40	Marked	Bus	63000	Shopping	
Park City	Olympic Pkwy (SR 224) at The Canyons	1	1000.0	1998	Signal	16,335	MA	2	55		None	41020	Residential	No
Payson	SR 198 0.18 mi north of city limit (MP 3.88)	1	1000.0	1998	None	5,000	C	2	55 40	Marked: School	None	41020	Business School	No
Perry	US 89 0.83 mi south of US 91	2	1100.0	2000	None	10,715	MA	4	50	None	Bus	41000	Business	
Pleasant Grove	State St at 820 South	3	1101.0	2000	None	21,770	PA	4	40				Business	
Price	100 North at 200 East	1	1000.0	1993	Stop	12,770	PA	2	30				Business	Yes
Provo	200 West at 1230 North	6	1032.0	2001	Signal ↓	17,515	MA	4	35	Marked	Bus	42000	Shopping	
Provo	300 South at 400 East	2	1010.0	1998	None	18,955	PA	4	30	Marked		41000	Business	
Provo	300 South midblock: 300 East-400 East	1	1000.0	1997	None	18,955	PA	4	30	None		41000	Residential	Yes
Provo	500 West at Center St	1	1000.0	1996	Signal	31,495	PA	4	35				Business	
Provo	900 East at 150 South	1	1000.0	1997	None	12,375	MA	3	35	None Center	Bus	41020	Residential	
Provo	South State St at 500 South	2	1010.0	1992	Signal	45,550	PA	6	50				Business	
Provo	State St at 1140 South	1	1000.0	1996	None	17,230	PA	4	50	None		41010	Business	Yes
Provo	University Av 1.00 mi south of 500 South	1	1000.0	1999	None	28,700	PA	4	0	None		61010	Shopping	Yes
Provo	University Av at 100 North	5	302.0	1998	Signal 20 sec	44,175	PA	4	35	Marked	None	42000	Business	Yes
Provo	University Av at University Pkwy	6	1140.0	2001	Signal 20 sec*	34,440	PA	4	35	Marked	None	61000	School Residential	
Riverton	2700 West at 8870 South	1	1000.0	1992	None	11,445	MA	2	0				Residential	
Riverton	Redwood Rd at 12900 South	2	1100.0	2000	None	11,525		2	40	None 12800 S	None	20020	Residential	
Roosevelt	200 North at 100 West	1	1000.0	1993	Warning	2,050	RA	2	35				Residential	No
Roy	1900 West at 5071 South	2	2000.0	1999	None	23,990	MA	4	45	None	Bus	41000	Residential	
Roy	5500 South at 4100 West?	9	333.0	2001	Signal None	23,385	MA	4 2	35 50	None	Bus	20020	Business	Yes
Salt Lake City	100 South at 1000 East	2	1010.0	2001	None	10,570	C	4	30	Marked	Bus	40020	Residential Medical	
Salt Lake City	100 South at 600 East	1	1000.0	1997	Stop None	10,370	C	4	30	Marked	Bus	40020	Residential	
Salt Lake City	1300 East at 3205 South	1	1000.0	1996	None	18,660	MA	4	40	None			Shopping	
Salt Lake City	1300 East at Wilmington Av	3	1011.0	2001	Signal	42,550	MA	6	40	Marked	Bus		Shopping	
Salt Lake City	1300 South + State St*	12	1560.0	2001	Signal 37-30	15,690 33,830	MA MA	4 6	0 35	Marked	Bus	61020	Shopping	Yes
Salt Lake City	1500 East at Yale Av-1080 South	1	1000.0	1999	None	5,611	L	2	25	Marked	Bus	20020	Residential	

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Salt Lake City	1700 South + 700 East*	6	1230.0	2001	Signal 42-29	14,530 48,645	MA PA	4 8	0 40	Marked Marked	Bus	41020 81100	School	Yes
Salt Lake City	200 East + 200 South*	7	331.0	2001	Signal 30-30*	14,590 16,275	C C	4 4	0 0	Marked Marked	Bus	41000 22010	Business	Yes
Salt Lake City	200 South + State St*	9	144.0	2001	Signal 48-23*	16,275 32,235	C MA	6 6	30 30	Marked Marked	Bus	52010 61020	Business	Yes
Salt Lake City	200 South + West Temple*	13	265.0	2001	Signal 35-53*	16,000 23,020	C MA	4 6	30 30	Marked Marked	Bus	41011 61000	Business	Yes
Salt Lake City	200 South at Rio Grande St (440 West)	7	232.0	1999	None	7,175	C	4	30	Marked	Bus	41021	Church <i>Shopping</i>	Yes
Salt Lake City	2100 South + 700 East*	8	62.0	2001	Signal 30-55	25,905 49,015	MA PA	4 8	35 40	Marked Marked	Bus	42000 82000	Shopping	Yes
Salt Lake City	2100 South at 200 East	4	1021.0	2001	Signal 25 sec+	21,455	MA	4	30	Marked	Bus	41000	Business	Yes
Salt Lake City	2100 South at 800 East	4	310.0	1999	Stop <i>None</i>	25,905	MA	4	30	Marked	Bus	41000	Business	
Salt Lake City	2200 West 0.15 mi south of 2200 North	1	1000.0	1998	None	3,928	C	2 3	0 45	None	Bus	30011	Residential <i>Industrial</i>	No
Salt Lake City	2700 South + 700 East*	7	250.0	1998	Signal 46-28	13,500 40,125	C PA	4 8	35 40	Marked Marked	Bus	41000 62000	Shopping	
Salt Lake City	2 <sup>nd</sup> Av midblock: Canyon Rd-A St	1	1000.0	1992	Other <i>None</i>	14,385	C	2	25	None A St	None	10021	Church	Yes
<i>Salt Lake City</i>	<i>300 East + 400 South*</i>	<i>6</i>	<i>213.0</i>	<i>1997</i>	<i>Signal 49-28*</i>	<i>10,100 28,550</i>	<i>C MA</i>	<i>2 6</i>	<i>35 35</i>	<i>Marked Marked</i>	<i>TRAX Bus</i>	<i>23110 51300</i>	<i>Business</i>	<i>Yes</i>
Salt Lake City	300 South + State St*	9	422.1	2001	Signal 49-24*	11,222 32,235	L MA	4 6	30 30	Marked Marked	Bus	42000 61010	Business <i>Shopping</i>	Yes
Salt Lake City	300 South + West Temple*	9	232.2	2001	Signal 34-49*	11,222 32,420	L MA	4 6	30 0	Marked Marked	Bus	31120 61000	Business	Yes
Salt Lake City	300 South midblock: 640 East- 700 East	1	1000.0	1992	None	10,627	L	4	0	None 700 E	None	40020	Residential	Yes
Salt Lake City	300 West 0.05 mi north of Hartwell Av	1	1000.0	1993	Other <i>None</i>	18,380	MA	4	0	None			Industrial	
Salt Lake City	300 West at 300 South	4	1111.0	2000	Signal 33 sec*	29,585	MA	6	30	Marked	None	61020	Business <i>Shopping</i>	Yes
Salt Lake City	300 West at 400 South	7	241.0	2001	Signal 43 sec*	20,320	MA	6	30	Marked	None	61020	<i>Shopping Business</i>	Yes
Salt Lake City	300 West at 500 North	3	1110.0	1999	Signal 27 sec	22,725	MA	6	40	Marked	Bus	61020	Residential <i>Shopping</i>	Yes
Salt Lake City	300 West at South Temple	2	1010.0	1998	Signal 40 sec+	29,585	MA	6	30	Marked	Bus	61120	Business	Yes
Salt Lake City	400 South at Main St	7	322.0	1999	Signal 26 sec*	25,770	MA	6	30	Marked	TRAX	31300	Business	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Salt Lake City	400 South at Pleasant Ct	5	1211.0	2001	Signal None	20,320	MA	6	30	None 200 West 300 West	Bus	60120	Business Shopping	Yes
Salt Lake City	600 North at 1100 West	3	1200.0	1997	None	15,400	MA	4	0 35	Marked	None	41020	Residential	
<i>Salt Lake City</i>	<i>600 North at 400 West</i>	<i>1</i>	<i>1000.0</i>	<i>1992</i>	<i>None Signal</i>	<i>29,250</i>	<i>MA</i>	<i>4</i>	<i>0</i>	<i>Marked</i>	<i>None</i>	<i>41020</i>	<i>Industrial</i>	<i>Yes</i>
Salt Lake City	600 North at Catherine St (1445 West)	2	1010.0	1996	None	18,985	MA	4	0	None Backman ES	None	41000	Residential	No
Salt Lake City	600 South + 700 East*	6	212.1	2001	Signal 69-23	7,813 42,270	C PA	4 8	40 40	Marked Marked	Bus	41020 81100	Residential	Yes
Salt Lake City	700 East at 800 South	5	301.1	2001	Signal 27 sec	42,270	PA	8	40	Marked	Bus	81100	Residential	Yes
Salt Lake City	700 East at 900 South	6	312.0	1996	Signal 83 sec	42,270	PA	8	40	Marked	Bus	81100	Residential	Yes
Salt Lake City	700 East at I-80 eastbound ramps	2	1100.0	1998	Signal ↓	40,805	PA	8	40	None	Bus	80000	Business	Yes
Salt Lake City	700 East at Simpson Av	3	2100.0	1999	None	44,380	PA	8	40	None 2100 S	None	80000	Business	Yes
Salt Lake City	900 East at 1300 South	4	310.0	2001	Signal	15,000	C	4	30	Marked	Bus		Shopping	
Salt Lake City	900 South + State St*	8	2132.0	1999	Signal 26	2,805 33,830	C MA	4 6	30 35	Marked Marked	Bus	31020 51020	Shopping	
Salt Lake City	900 West + Indiana Av (800 South)*	11	541.1	2001	Signal 26	18,045 11,395	C C	4 2	35 0	Marked Marked	Bus	41020 41011	Shopping	Yes
Salt Lake City	900 West + North Temple*	9	252.0	2001	Signal 41	13,125 28,980	C MA	2 6	40 35	Marked Marked	Bus	31000 62000	Shopping	
Salt Lake City	900 West at 700 South	3	1110.0	2000	None	18,515	C	4	35	Marked	Bus		Residential	
Salt Lake City	900 West midblock: 700 North-800 North	1	1000.0	1994	None	13,315	C	2	0				Business	
Salt Lake City	900 West midblock: 700 North-Diamond Rose Cir	2	1010.0	2000	None	13,665	C	4	35	None 700 N	Bus	41020	Residential	Yes
Salt Lake City	California Av 0.3 mi west of Redwood Rd	1	1000.0	1996	None	18,030	MA	4	40	None Redwood	None		Industrial	
Salt Lake City	Highland Dr-1100 East + 2100 South*	8	61.1	2001	Signal 56-56*	14,255 23,350	C MA	2 4	30 30	Marked Marked	Bus	22000 41000	Shopping Business	Yes
Salt Lake City	I-80 1.33 mi west of 7200 West interchange	1	1000.0	1998	None	16,350	F	4	75	None	None	40120	Open Land	No
<i>Salt Lake City</i>	<i>Main St at Market St (340 South)</i>	<i>6</i>	<i>222.0</i>	<i>1996</i>	<i>Signal 28 sec*</i>	<i>15,200</i>	<i>C</i>	<i>4</i>	<i>0</i>	<i>Marked</i>	<i>TRAX</i>	<i>20320</i>	<i>Business</i>	<i>Yes</i>
Salt Lake City	North Temple midblock: 800 West-700 West	2	1010.0	1995	None	27,940	MA	6	35	None 800 West 700 West	Bus	61000	Shopping	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Salt Lake City	North Temple at 1460 West	2	1100.0	2000	None <i>Signal</i>	25,090	MA	5	45	None <i>Marked</i>	Bus	61000	Business	Yes
Salt Lake City	North Temple at 1950 West	1	1000.0	1995	None <i>Signal</i>	32,175	MA	6	50	Marked	Bus	61020	Business	Yes
Salt Lake City	North Temple at Cornell St	4	1201.0	2001	None	21,990	MA	5	45	None 1460 W	Bus	61000	Business	Yes
Salt Lake City	North Temple at Main St	5	311.0	2000	Signal 23 sec	25,855	MA	4	30	Marked	Bus	42000	Business <i>Church</i>	Yes
Salt Lake City	North Temple midblock: 600 West-700 West	1	1000.0	1996	None	28,980	MA	6	35	None 600 W	None	61020	Business	
Salt Lake City	North Temple midblock: east of 1950 West	5	2201.0	1998	None	33,300	MA	6	50	None 1950 W	Bus	61020	Business	Yes
Salt Lake City	Pioneer Rd at 1880 South	1	1000.0	2001	None	11,985	MC	2	30	None	Bus	41020	Industrial	No
Salt Lake City	Redwood Rd 0.5 mi north of California Av	2	1100.0	1998	None	22,155	MA	4	50 45	None	Bus	62000	Industrial	
Salt Lake City	Redwood Rd at 500 South	5	1121.0	2001	Signal	22,155	MA	4	50 45	Marked		51000	Industrial <i>Business</i>	
Salt Lake City	Redwood Rd midblock: Dalton Av-900 South	1	1000.0	1998	None	22,155	MA	4	50	None			Industrial	No
Salt Lake City	South Campus Dr at parking lot entrance adjacent Huntsman Center	3	1110.0	1997	None	16,065	MA	4	25	Marked	TRAX Bus	30100	School	Yes
Salt Lake City	South Campus Dr midblock: Campus Center Dr loop	4	1120.0	1996	Signal 30 sec	16,065	MA	4	25	Marked	TRAX Bus	30100	School <i>Church</i>	Yes
Salt Lake City	South Temple + State St*	9	162.0	2001	Signal 46-23*	14,000 32,235	C MA	4 6	30 35	Marked Marked	Bus	42000 52000	Business Shopping	Yes
Salt Lake City	State St + 400 South*	14	1445.0	2000	Signal 38-43*	32,235 28,550	MA MA	6 6	35 30	Marked Marked	TRAX Bus	61120 62210	Business	Yes
Salt Lake City	State St at 100 South	7	1321.0	2001	Signal 23 sec	32,235	MA	6	30	Marked	Bus	61020	Business	Yes
Salt Lake City	State St at Belmont Av	1	1000.0	1994	Signal	32,220	PA	6	35				School	
Salt Lake City	State St at Cleveland Av	3	1101.0	2000	None	31,200	MA	6	35	None 1300 S	Bus	61020	Shopping	Yes
Salt Lake City	State St at Exchange Pl	16	753.1	2001	None	32,235	MA	6	30	Marked	Bus	60010	Business	Yes
Salt Lake City	State St at Kensington Av	2	1010.0	1996	None	31,200	MA	6	35	None 1300 S	Bus	62000	Shopping	Yes
Salt Lake City	State St at Westminster Av	7	142.0	1999	Signal 15 sec	31,375	MA	6	30	Marked	Bus	62000	Business Shopping	Yes
Salt Lake City	Wasatch Dr 0.05 mi s/o Michigan Av	1	1000.0	2000	None	2,300	L	2	25	Marked	None	20000	Residential <i>Golf</i>	
Salt Lake City	West Temple + South Temple*	3	1100.1	1997	Signal 58-46*	23,020 17,500	MA C	2 4	30 35	Marked Marked	TRAX Bus	42000 22300	Business	Yes
Sandy	1300 East at 10020 South	1	1000.0	1992	None	29,435	MA	2	0				Residential	No
Sandy	225 West at 9155 South	1	1000.0	1997	None	6,210	C	2	35	None	None	21000	Business	No

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Sandy	9400 South at Poppy Lane (945 East)	2	1001.0	1996	None	26,940	MA	2	35 40	Marked	Bus	41000	Business <i>Residential School</i>	No
Sandy	State St + 9000 South*	9	251.1	2001	Signal 24-26	23,875 23,005	MA PA	4 3	40 40	Marked Marked	None	43010 42010	Shopping	Yes
Sandy	State St midblock: 10000 South-Alta View Wy & Beetdigger Bl	1	1000.0	1992	None	21,745	PA	4	45	None 10000 S Alta View	None	41020	Business	
South Jordan	Redwood Rd at 9400 South	1	1000.0	1993	None	15,520	MA	2	45				Business	
South Ogden	Harrison Blvd at 5600 South	2	1100.0	2000	Signal	22,045	PA	4	0				Business	
South Ogden	Washington Blvd at 38 <sup>th</sup> St	4	1111.0	1997	Stop None	22,615	PA	4	30				Business	
South Salt Lake	3300 South at 300 West	2	1001.0	2001	Signal	43,245		6	35	Marked	Bus	62020	Industrial	Yes
South Salt Lake	State St at Claybourne Av	4	1210.0	2001	None	33,300	MA	6	35	None Sunset	Bus	61020	Business <i>School</i>	Yes
South Salt Lake	State St at Ford Av	3	1110.0	2000	None	29,685		6	35	None 3300 S	Bus	61020	Business	Yes
South Salt Lake	State St at Sunset Av	6	1230.0	2000	None <i>Signal*</i>	36,185	PA	6	35	Marked	None	60120	Business	Yes
South Salt Lake	State St at Utopia Av	5	320.0	1999	None	41,180	PA	6	35	None 2100 S	Bus	60100	Shopping	No
Spanish Fork	Main St at 200 North	6	211.0	2000	Signal 19 sec	23,150	MA	4	30	Marked	None	41020	Business	Yes
Springville	400 North at 300 East	1	1000.0	1997	None	2,219	L	4	0 25	None	None	20020	Residential	
Springville	Center St at 400 East	2	1100.0	1998	None	4,540	C	2	25 30	Marked	Bus	41000	Residential	
Springville	Main St at 200 South	4	2020.0	2001	Signal None	17,085	PA	2 4	30	Marked	None	41020	Business	Yes
Springville	Main St midblock: 200 South-300 South	1	1000.0	2001	None	17,085	PA	4	30	None 200 S	None	41020	Shopping	Yes
St. George	Bluff St at 900 South	1	1000.0	2001	None	17,355	PA	4	45				Business	Yes
St. George	St. George Blvd at Main St	4	1011.1	2000	Signal	33,735	PA	4	30	Marked			Business	
Summit County	I-80 1.76 mi east of Ranch exit	1	1000.0	1992	None	9,430	F	4	65	None	None	40120	Open Land	
Sunset	Main St 0.07 mi south of 1300 North	1	1000.0	2001	None	21,360	MA	4	45	None		41000	Business	No
Taylorsville	3200 West at 5620 South	2	1010.0	1993	Flasher	10,260	C	2	35	Marked: School	Bus		Residential	
Taylorsville	6200 South at Sternwood Dr	1	1000.0	1992	None	19,555	MA	2	0				School	
Taylorsville	Bangerter Highway 0.1 mi north of 6200 South	2	1000.1	1997	None	30,500	PA	6	50	None 6200 S (bridge)	Bus		Open <i>Residential</i>	
Taylorsville	Redwood Rd + 4100 South*	19	515.0	2001	Signal 36	36,540 30,135	MA MA	4 4	40 0	Marked Marked	Bus	42020	Shopping	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
Taylorsville	Redwood Rd at 4200 South-MantleAv	8	143.0	2001	None <i>Signal 26 sec</i>	39,910	MA	4	40	Marked	Bus	62000	Business	No
Taylorsville	Redwood Rd at 5245 South	4	1021.0	2000	Signal?	55,240	MA	4	50	Marked?	Bus		Residential School	
Taylorsville	Redwood Rd at Murray-Taylorsville Rd	7	421.0	1999	Signal <i>None</i>	55,240	MA	4	40 45		Bus	62010	Business	No
Tooele	Main St at 500 North	4	400.0	1994	Signal <i>None</i>	20,315	PA	4	35	None 400 N	Bus	41020	Shopping	Yes
Tooele County	I-80 16.02 mi west of Knolls interchange	1	1000.0	2001	None	7,255	F	4	75	None	None	<u>40120</u>	Open Land	No
Tooele County	I-80 2.62 mi west of Delle interchange	1	1000.0	1998	None	7,790	F	4	75	None	None	<u>40120</u>	Open Land	No
Tooele County	SR 36 at milepost 60.23	1	1000.0	1993	None	8,735	PA	2	55				Residential	No
Tremonton	I-84 0.54 mi south of SR 102 interchange	1	1000.0	1992	Other <i>None</i>	5,965	F	4	65	None	None		Farms	No
Tremonton	Main St at Tremont St	3	1020.0	1993	Signal 21 sec	6,860	RA	2	30	Marked	None	21020	Shopping	Yes
Uintah County	US 40 0.84 mi west of road to Fort Duchesne	1	1000.0	1994	None	5,340	PA	3	55		None		Open Land	No
Utah County	US 6 3.58 mi east of Sheep Creek Rd	1	1000.0	1998	None	5,775	PA	2	55	None	None		Open Land	
Washington County	I-15 1.21 mi north of Toquerville interchange	1	1000.0	1999	None	11,935	F	4	65	None	None	<u>40120</u>	Open Land	
Washington County	SR 9 0.85 mi west of Rockville city limit	1	1000.0	1995	None	3,060	PA	2	55				Open Land	
Wendover	Wendover Bl at Wildcat Way (400 East)	1	1000.0	1999	None	11,310	RA	4	35	Marked: School	None	40020	Business	Yes
West Haven	4000 South at 4550 West	1	1000.0	1998	None	1,825	RA	2	55 50	None	None	<u>20000</u>	Residential <i>Church</i>	
West Haven	Wilson Lane at 1100 West	2	1100.0	2000	Signal 31 sec	11,855	MA	4	55	Marked	None	52010	Open	No
West Jordan	7000 South at 3420 West	2	1010.0	1997	None	7,580	MA	2	35	Marked: School	Bus		Residential <i>School</i>	
West Jordan	Redwood Rd 0.48 mi n/o 7000 South	1	1000.0	1995	None	29,995	MA	4	50		Bus	61000	Business	
West Valley City	2700 West + 3500 South*	6	222.0	2001	Signal	17,445 46,060	C PA	4 6	35 40	Marked Marked	Bus	64000	Shopping	Yes
West Valley City	3100 South at 2700 West	6	231.0	2001	Signal 28 sec	10,170	C	2	35	Marked	Bus	41000	Business	Yes
West Valley City	3100 South at Valley Crest ES	1	1000.0	1996	None	3,600	C	2	0				School	
West Valley City	3200 West at 4395 South	1	1000.0	1992	None	11,960	C	2	0				Residential	No
West Valley City	3500 South 0.08 mi west of Bangerter Hwy	3	1110.0	1998	None	39,860	PA	4	0 40	None Bangerter	Bus	51010	Business	Yes

City or County	Location	Crashes	Score	Year	Control	AADT	FC	Lanes	Speed	Crossing	Transit	Width	Land Use	Lighting
West Valley City	3500 South at 4200 West	1	1000.0	1998	None	25,205	PA	4	40	None 4155 W	Bus	41000	Residential	Yes
West Valley City	3500 South at 6800 West	2	1100.0	1996	None	18,895	PA	2	45	None	Bus	22000	Business	No
West Valley City	3500 South at Redwood Rd	12	570.0	2001	Signal 26 sec	41,625	PA	6	40	Marked	Bus	61020	Shopping	Yes
West Valley City	4000 West + 3500 South*	6	231.0	2001	Signal 70-23	17,397 39,860	L PA	2 4	35 40	Marked Marked	Bus	32020 42000	Business	Yes
West Valley City	4000 West at Continental Dr (4225 South)	2	1010.0	2001	None	17,397	L	2	35	None 4100 S	Bus	21020	Residential	Yes
West Valley City	5600 West at 2100 South frontage (south)	1	1000.0	1994	None	22,900	PA	4	50	None			Industrial	
West Valley City	Redwood Rd at 2320 South- Decker Lake	5	2030.0	2000	Signal 20 sec	37,890	MA	5	40	Marked	Bus	41020	Business Shopping	Yes
West Valley City	Redwood Rd at 2560 South	1	1000.0	1993	None	36,340	MA	4	40				Industrial	
West Valley City	Redwood Rd at 3100 South	3	1200.0	2000	Signal 25 sec	37,890	MA	4	40	Marked	Bus	61000	Shopping	Yes
West Valley City	Redwood Rd at 3395 South	3	1101.0	2000	None	37,890	MA	4	40	None 3300 S	None	61020	Shopping Residential	Yes
West Valley City	Redwood Rd at Redwood Pl	1	1000.0	2000	None	36,540	MA	4	40	None			Shopping	
West Valley City	Redwood Rd at Whitlock Av- Parkway Bl	6	411.0	2001	Signal 20 sec	37,890	MA	4	40	Marked	Bus	61000	Business Residential Shopping	Yes
West Valley City	SR 201 at Bonneville Raceway	1	1000.0	2000	None	25,800	PA	4	55 60	None	None	40120	Open Land	No
West Weber	1150 South at 5100 West	1	1000.0	1997	None	4,095	RA	2	50	None	None	20000	Residential	No
West Weber	4700 West at North Branch West Weber Canal	1	1000.0	2001	None	1,850	RA	2	40	None	None	20000	Farms	No

NOTES: All data were collected during 2003 and 2004. Italicized entries indicate locations that had undergone major reconstruction since the time of the most recent pedestrian-vehicle incident. Please refer to the text for information about how the sampled sites were selected. Isolated italicized entries pertain to field observations that were different from data provided in the CDDS. ES = elementary school.

City or County: Incidents occurring in unincorporated areas are listed according to the respective counties.

Location: An “\*” next to the location indicates that crashes occurred in crossing both of the streets listed. Otherwise, the crash occurred when the pedestrian was crossing the first street listed.

Crashes: The number of pedestrian-vehicle collisions occurring between 1992 and 2001.

Score: The severity score, as explained in the technical document.

Year: The most recent year in which a pedestrian-vehicle crash occurred at the given location.

Control: + = signal beeps or chirps; x sec = walking man and flashing upraised hand time; x-y = walking man and flashing upraised hand times on each of the two crossings; ↓ = pushbutton not functioning.

AADT: When two AADTs are listed, they pertain to the first and second road under “location,” respectively.

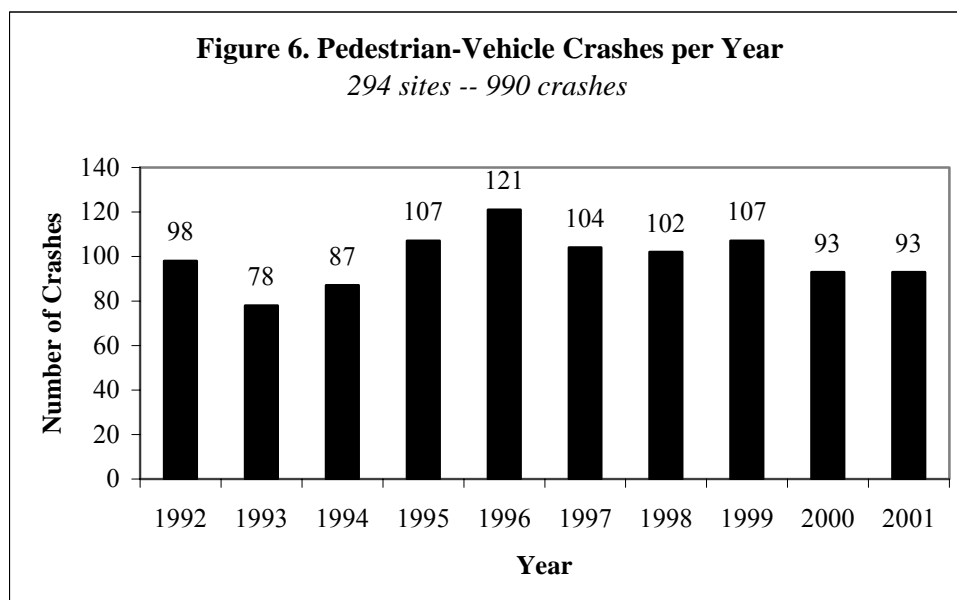
FC: Functional classification, as follows: F = freeway, PA = other principal arterial, MA = minor arterial, RA = major arterial (rural areas only), C = collector, RC = major collector (rural areas), MC = minor collector (rural), and L = local.

Lanes:	The number of lanes is the number of through lanes, not necessarily the number of lanes that must be crossed by a pedestrian.
Speed:	The speed is the speed limit, not necessarily the speed of the motor vehicle at the time of the incident.
Crossing:	A “#” adjacent “None” in the crossing column indicates that signing for a crossing is provided, but there is no marked crosswalk. “School” underneath “Marked” indicates a school crossing. A street name or distance underneath “None” indicates the nearest (or distance to the nearest) marked crossing.
Transit:	If a bus or TRAX stop is within a short distance of the location, then “Bus” or “TRAX” is indicated.
Width:	The width of the crossing is presented as a sequence of five numbers, as follows: through lanes, turning lanes, median, shoulders, and bicycle lanes. When the number sequence is underlined, there was no sidewalk on one or both sides of the road crossed.

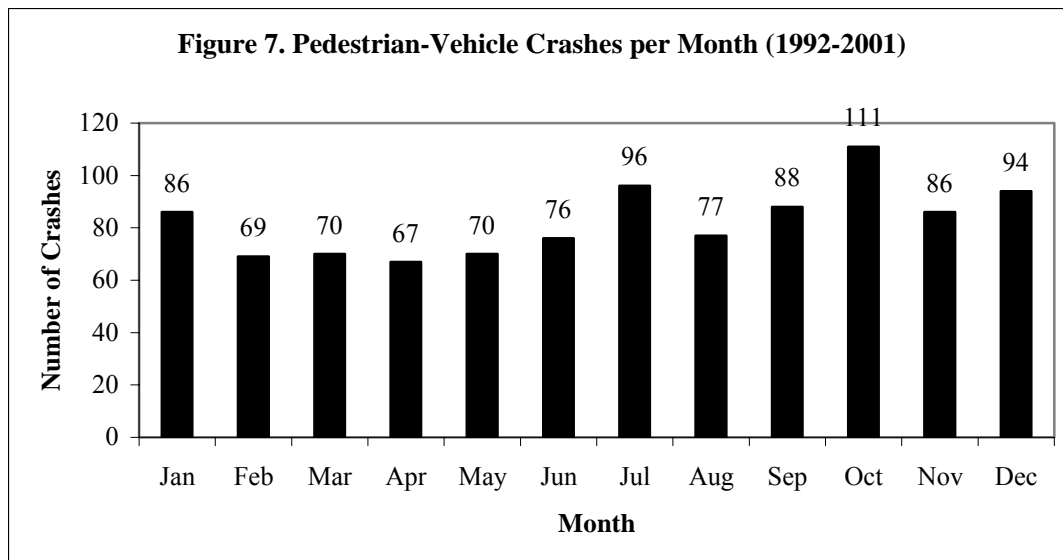
## CHAPTER 6. Summary of Pedestrian-Vehicle Crash Characteristics

### Crash-Related Statistics

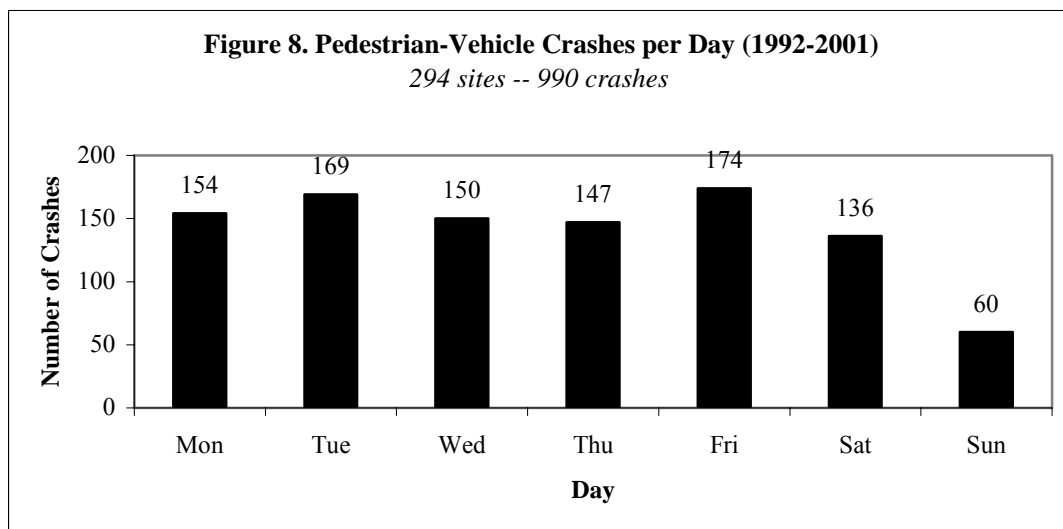
**Year.** A discussion of the number of pedestrian-vehicle crashes occurring each year during the 1992-2001 study period was provided in Chapter 3 of this document. A declining trend in the number of pedestrian-vehicle crashes per year was noted. A substantial dropoff in the number of crashes from 1996 to 1997 was attributed to a change in UDOT's crash reporting policy. Within the sample of 294 pedestrian-vehicle crash sites, though, there was no discernible trend. That is, the number of crashes remained fairly steady from 1992, in which there were 98 incidents, to 2001, in which there were 93 incidents. The year 1996 crashes, at 121, were the highest of the study period; the drop to 104 crashes in 1997 was probably directly related to the change in crash reporting policy. The values are displayed in Figure 4. The indication is that the sites chosen for the sample remained, perhaps, "unimproved" for the duration of the study period. That is, external factors such as changes in the amount of motor vehicle traffic, changes in the amount of walking, safety improvements, and so forth did not have a noticeable effect on the annual crash figures.



**Month.** By month of the year, over the 10-year study period, the number of pedestrian-vehicle crashes ranged from 67 in April to 111 in October. The average number of crashes per month was 82.5, and the median was 81.5. October was by far the "busiest" month for pedestrian-vehicle crashes, although its value was not quite an outlier. A combination of school and recreational activities, along with moderate temperatures were probably factors in making October the busiest month for pedestrian-vehicle incidents. The second-busiest month was July, a mid-summer month, at 96 incidents, followed by December with 94 incidents. The heavy pedestrian-vehicle crash activity in December was contrary to the presumption that a winter month would see a lower amount of pedestrian activity. One conclusion is that October may be a choice month during which to conduct pedestrian volume counts or surveys. The statistics are summarized in Figure 5.

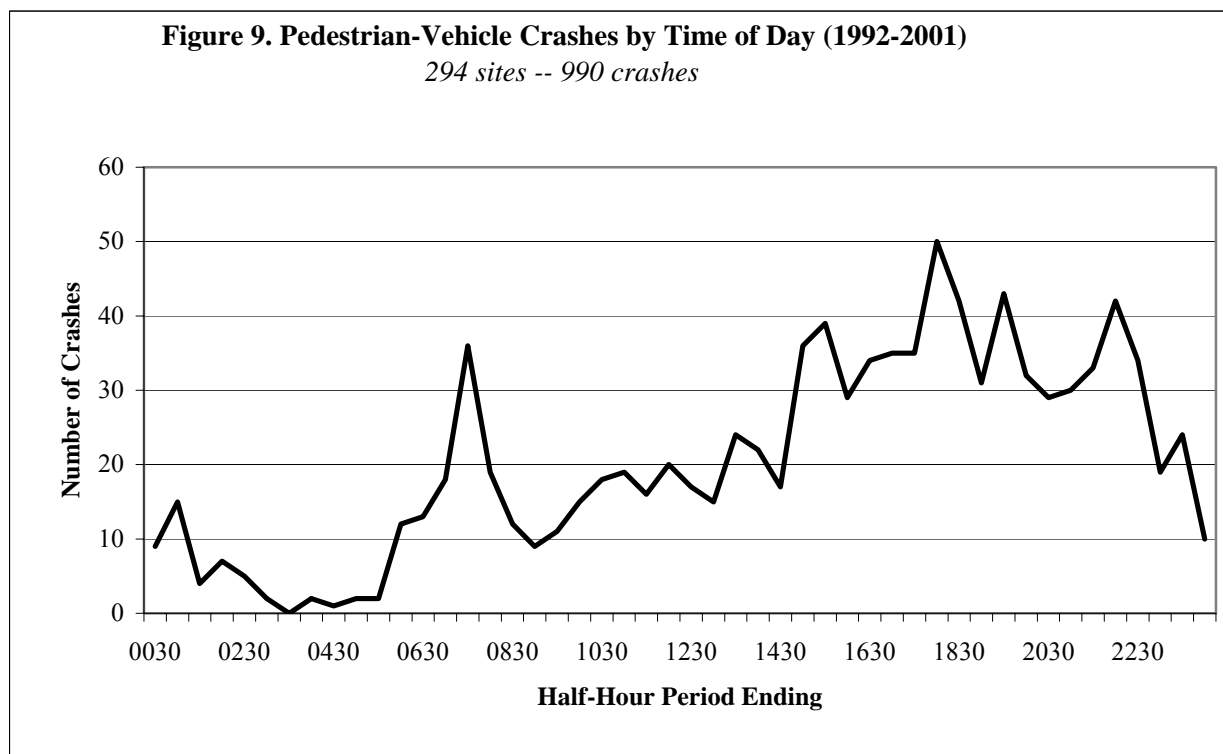


Day of the Week. Over the 10-year study period, the number of pedestrian-vehicle crashes ranged throughout the week from 154 on Mondays to 136 on Saturdays, with Friday as the peak day (174 incidents). Tuesday was the second most active day, with 169 crashes. Sunday was an outlier, with just 60 incidents. It is evident that Sunday saw a reduced amount of pedestrian activity, or at least a decrease in pedestrian exposure to motor vehicles, when compared to the other days of the week. The day of the week statistics are summarized in Figure 3. From Monday to Saturday, the average number of pedestrian-vehicle incidents per day was 155, with a standard deviation of 14.20. The coefficient of variation (the ratio of the standard deviation to the mean) was just 0.092, indicating that the variation about the mean, from day to day, was not substantial.

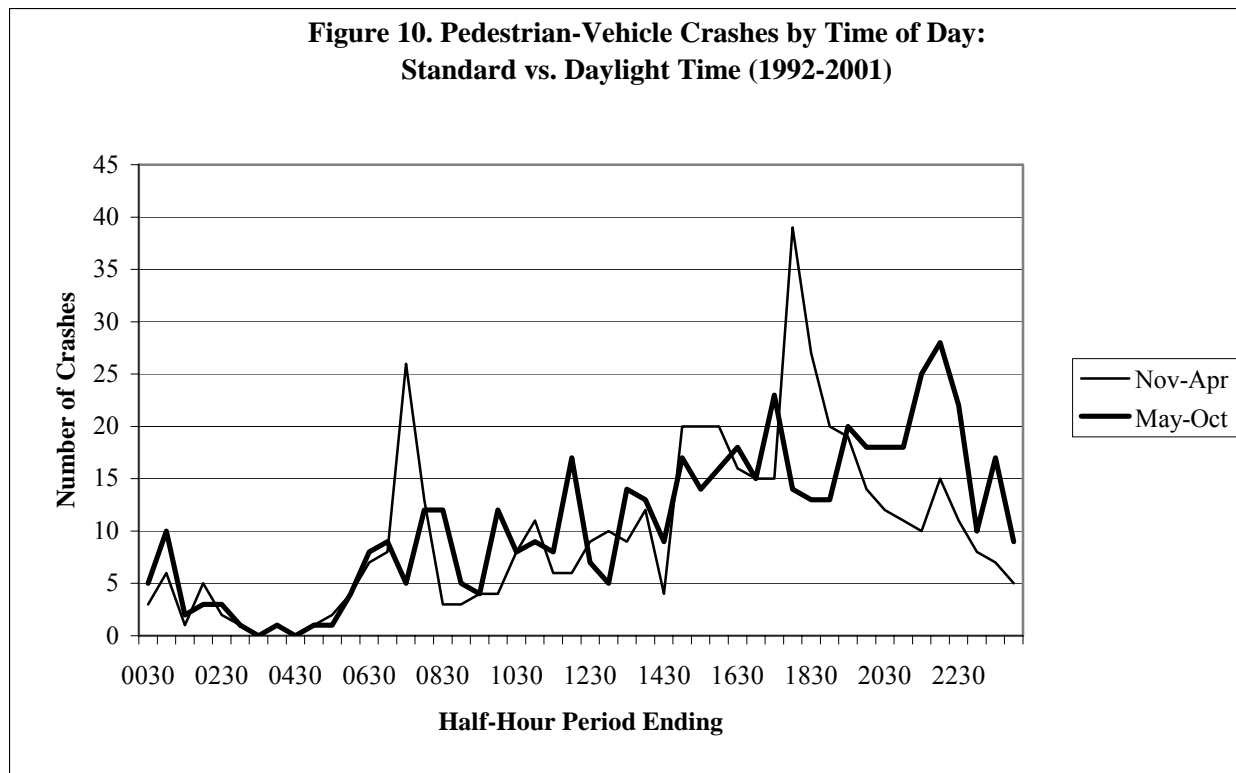


Time of Day. The 990 pedestrian-vehicle crashes occurring at the 294 sampled sites between 1992 and 2001 were tabulated according to the time of day of the incidents. Thirty-minute time blocks were used. Figure 4 displays the time distribution of crashes. The peak 30-minute period occurred from 5:30 to 6:00 PM, with 50 incidents, and the peak hour was from 5:30 to 6:30 PM, with 92 incidents. The peak two-

hour period was from 5:30 to 7:30 PM (166 incidents); the peak three-hour period was from 4:30 to 7:30 PM (236 incidents); the peak four-hour period was from 4:00 to 8:00 PM (302 incidents); and the peak eight-hour period was from 2:30 to 10:30 PM (574 incidents, or 58.0 % of all incidents). The evidence is that pedestrian-vehicle crashes were most prominent during mid- and late-afternoon hours, along with early- and late-evening hours. A small morning peak occurred between 7:00 and 7:30 AM (36 incidents); otherwise, no more than 24 incidents occurred during any other half-hour period outside of the peak eight hours. Incident totals remained between 9 and 24 per half-hour between 7:30 AM and 2:30 PM. Only 25 crashes occurred during late-night hours (1:00 to 6:00 AM). The data are displayed in Figure 7.

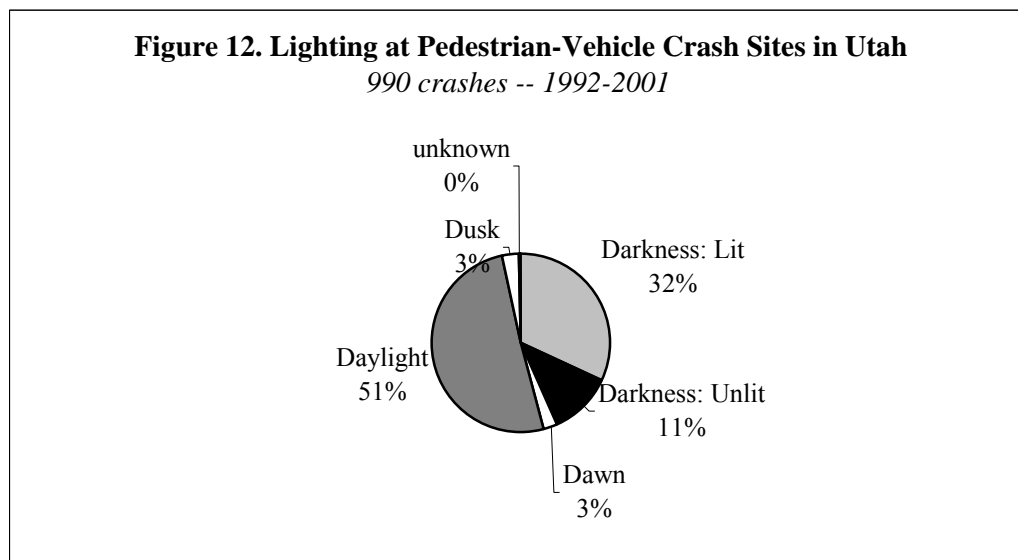
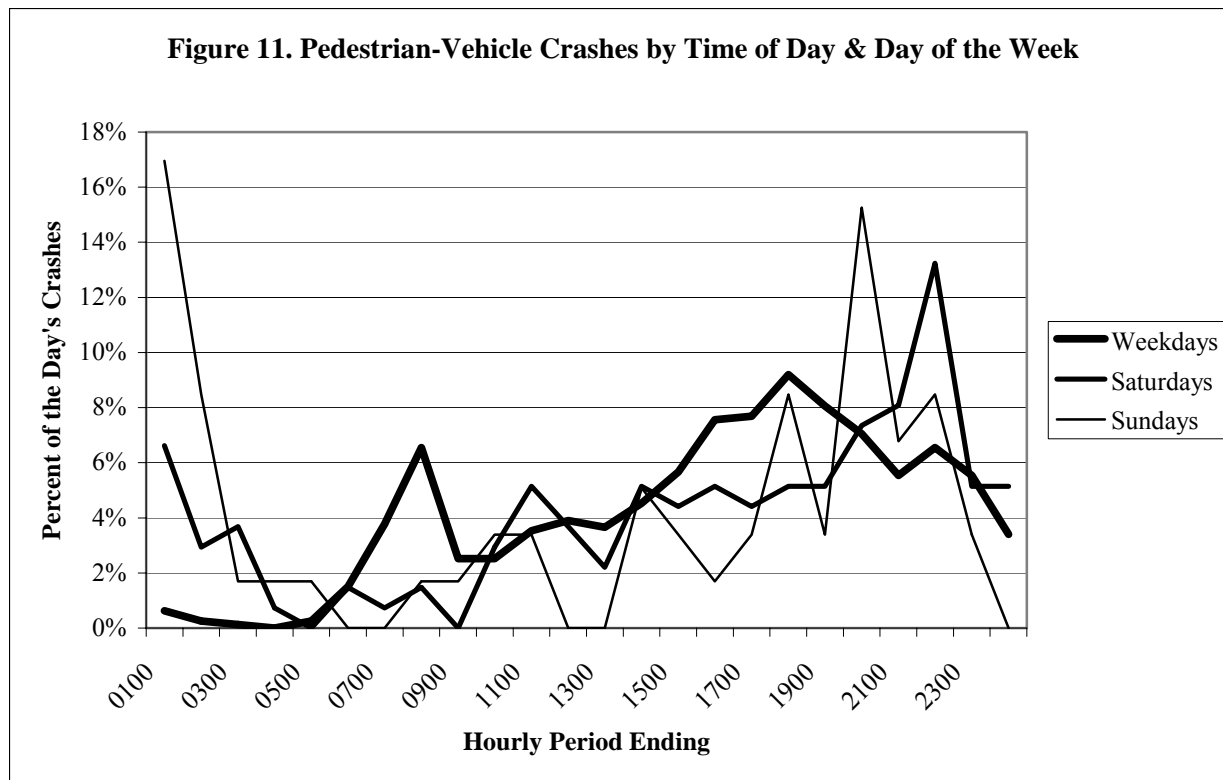


There was a supposition that the distribution of crashes might vary by season of the year; that is, according to the length of daylight per day. To examine this possibility, Figure 8 displays the time-of-day distribution of pedestrian-vehicle incidents by “standard” time months (November through April) and “daylight savings” time months (May through October). A total of 474 pedestrian-vehicle crashes (47.9%) occurred between November and April, while 516 (52.1%) occurred between May and October. Reading from the left, the two distributions were strikingly similar until the evening hours (5:30 PM to 12 midnight). The exception was a 7:00-7:30 AM peak that occurred during the November-April months that was absent during the May-October period. Around 5:30 PM, the November-April distribution surged toward an evening peak, while the May-October distribution dipped. Then, around 7:30 PM, the May-October distribution began to surge, while the November-April curve began a decline. The indication is that there was a greater amount of pedestrian activity and exposure during the late evening and early nighttime hours between May and October than there was during the November-April months. Indeed, the peak pedestrian-vehicle “crash hour” was from 5:30 to 6:30 PM between November and April, but between 9:00 and 10:00 PM from May to October. At both times of the year, the peak occurred outside of daylight hours.



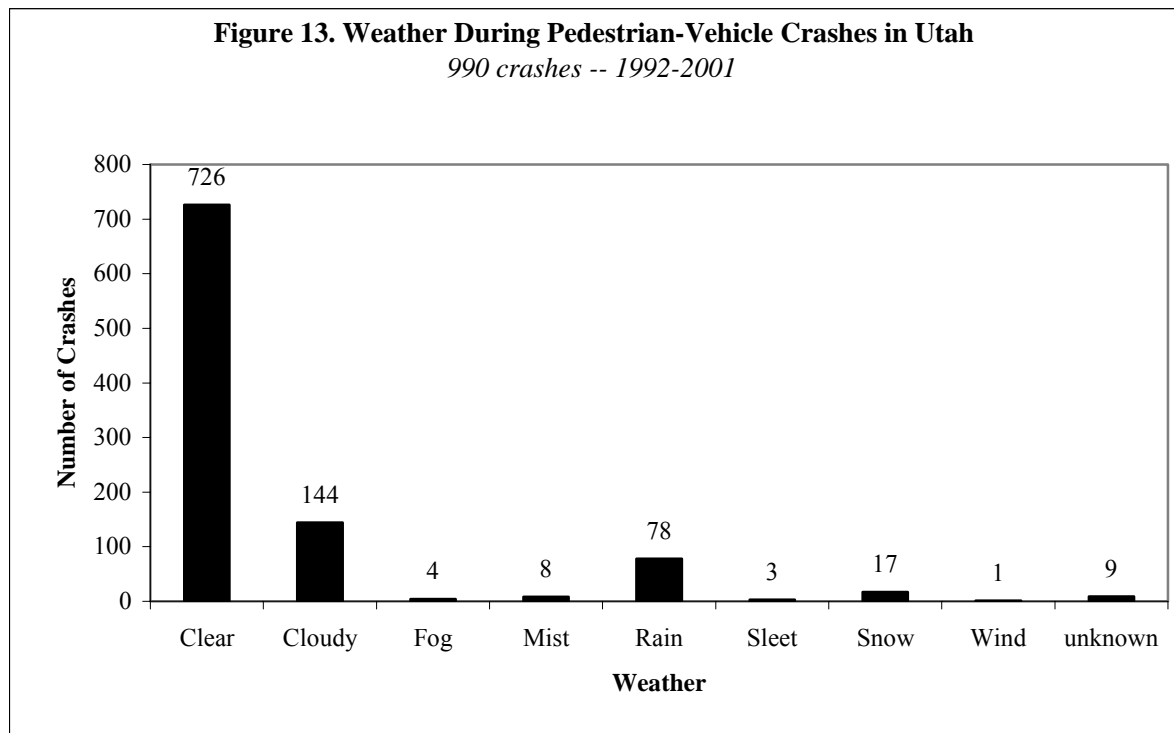
The possibility of a difference between the time-of-day distributions of crashes on weekdays and weekends was also investigated. The possibility of a difference between the time-of-day distributions of crashes on weekdays and weekends was also investigated. Time-of-day distributions for weekday (Monday-Friday), Saturday, and Sunday incidents were prepared. The distributions are displayed in Figure 9. It is evident that the greatest proportion of late evening and nighttime crashes, in comparison with that day's crashes, occurred on Saturdays and Sundays (i.e., Friday and Saturday night). These incidents may have been related to socio-recreational activities, perhaps involving the consumption of alcoholic beverages. Lighting conditions and visibility may have also been factors in these crashes.

**Lighting Conditions.** One of five different lighting conditions is recorded in the CDDS for each pedestrian-vehicle crash: daylight, darkness with street or highway lighting, darkness with no lighting, dawn, or dusk. About half of the 990 sampled incidents (502 or 50.7%) occurred during daylight. A total of 429 incidents (43.3%) occurred during darkness. Of the crashes occurring in darkness, 73.9% occurred under street or highway lighting, while the remaining 26.1% occurred where there was no lighting. The remaining 55 incidents (5.6%) were split between dawn and dusk, while no entry was made for four of the incidents. One conclusion is that inadequate lighting may have been a causal factor in the 112 crashes (11.3% of all crashes) in which there was no lighting. It is likely that improved lighting conditions would be a remedial strategy in some of these cases. In contrast, other remedial strategies would be evident for the crashes that occurred in daylight. It is not known if the lighting was adequate in the cases in which a crash occurred at night under street or highway lights. Locations at which crashes recur at night should be considered for lighting improvements. An in-depth tabulation of locations having recurrent nighttime crashes was beyond the scope of this research. The lighting data are summarized in Figure 10.



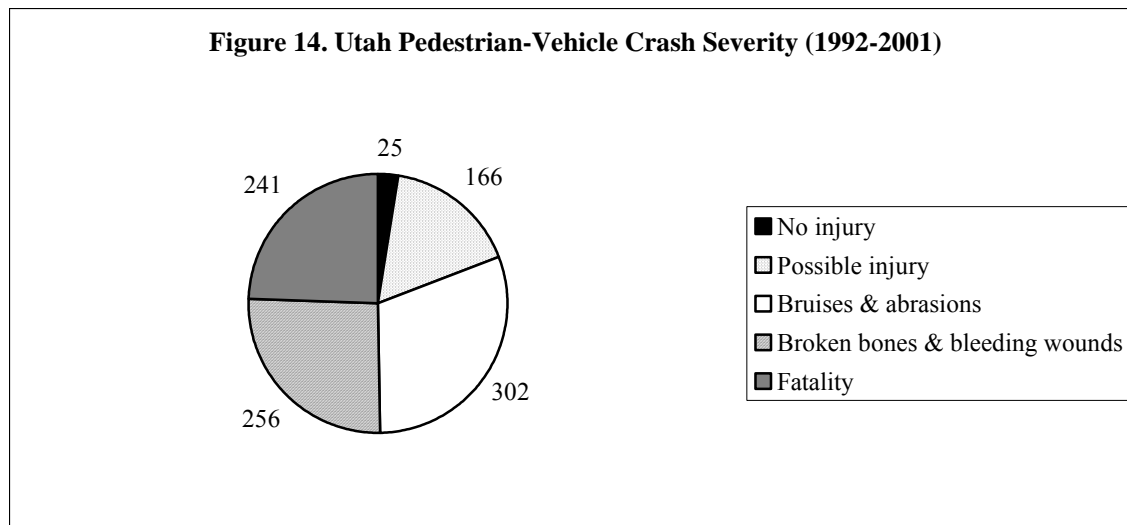
Weather. One of eight different weather conditions is recorded in the CDDS for each pedestrian-vehicle crash. A surprisingly large number of the 990 sampled incidents occurred during either clear (726 or 73.3%) or cloudy (144 or 14.5%) conditions. Of the remaining 120 incidents, 78 (7.9%) occurred during rain, 17 (1.7%) occurred during snow, 8 (0.8%) occurred during mist, 4 (0.4%) occurred during fog, 3 (0.3%) occurred during sleet, and 1(0.1%) occurred during a windstorm; the weather during nine of the

incidents was not recorded. The indication is that inclement weather conditions may have been a factor in about 11.2% of all incidents. The weather conditions data are displayed in Figure 11.



**Severity.** The emphasis in selecting the 294 pedestrian-vehicle crash sites was on those with high crash severity scores. The tendency among the 990 crashes at these sites, therefore, was toward severe crashes. As discussed earlier in this report, one of the five crash severity scores is recorded in the CDDS for each incident. As expected, “no injury,” the least severe result, occurred in only 25 (2.5%) of the crashes. A “possible injury” was the result in 166 (16.8%) of the crashes, while bruises and abrasions occurred in 302 (30.5%) of the crashes. The latter was the most common type of injury. Broken bones and bleeding wounds were the outcome in 256 (25.9%) of the incidents, and 241 (24.3%) of the crashes resulted in fatalities. The 241 fatalities in the sample represented 71.9% of all fatalities that resulted from pedestrian-vehicle crashes in Utah between 1992 and 2001. The severity data are presented in Figure 12.

**Year of Most Recent Incident and Crash Recurrence.** At each of the 294 sampled crash sites, the year of the most recent incident was noted. The purpose of this exercise was to identify that had not experienced a crash for several years. At these sites, it is likely that changes in demand characteristics, supply characteristics, or both had fostered an improvement in pedestrian safety. The infrastructure and motor vehicle demand levels at these sites would be subject to further investigation later in the research. At 68 of the sites, at least one pedestrian-vehicle collision occurred in 2001, the most recent year of the study period. A crash occurred most recently in 2000 at 38 of the sites, and in 1999 at 28 of the sites. Thus, at least one crash occurred within the final three years of the study period at 134 (70.5%) of the sites. At least one crash occurred within the last five years of the study period (1997-2001) at 167 (87.9%) of the sites. No crash occurred since 1996 at 23 (12.1%) of the sites. Given the long time period since the last crash at these sites, it is possible that changes in demand or supply (or both) affected pedestrian safety.



The pedestrian-vehicle crash rates at the 294 sites were further examined. It is common practice to assume that crashes occur according to a Poisson distribution. Under this assumption, it is possible to determine the probability that one or more crashes will occur within a certain time period. The average crash rate at each of the 294 sites was easily determined by dividing the number of crashes by the 10-year study timeframe. Thus, two-crash sites experienced an average of one crash every five years, or 0.2 crashes per year. The average crash rate at three-crash sites was one every 3.33 years, or 0.3 crashes per year. At the extreme end of the crash recurrence site, one site experienced 19 incidents, or an average of 1.9 per year. The formulation of the Poisson distribution is as follows:

$$P(X=x) = [(\lambda t)^x e^{-\lambda t}] / x!, \text{ where} \quad [2]$$

$X$  = a random variable representing the number of crashes that occur at a site,  
 $x$  = a value of  $X$ ,  
 $\lambda$  = the average crash rate at the given site, and  
 $t$  = the time length of the study period.

The probability that no crashes will occur during a given time period can be found by setting  $X$  equal to zero, and letting  $t$  be the length of the period. Substituting  $X = 0$  into equation [2] produces:

$$P(X=0) = e^{-\lambda t} \quad [3]$$

Table 14 lists the probability that there will be no crash during a specified time period for a given crash recurrence rate. At two-crash sites, for example, the probability that no crash will occur during a two-year period is 67.03%. Each probability value in the table can be interpreted as the probability that no crash would have occurred between the time of the most recent crash and the end of year 2001. For example, the probability that no crash would have occurred between 1999 and 2001 at a site that experienced seven crashes between 1992 and 1998 is 12.25%. The bold numbers pertain to crash sites in the sample. The bold, italicized numbers pertain to sites at which there was less than a 10% chance that a crash would not occur during the time interval since the most recent crash. The deduction is that there may have been one or more changes in the demand and supply characteristics at these sites, thereby precipitating an improvement in pedestrian safety. There are seven such sites; these are listed below. The number of pedestrian-vehicle crashes occurring between 1992 and 2001 is in parentheses, along with the last year that a crash occurred and the probability of no crash occurring since that time:

**Table 14. Probabilities of Zero Pedestrian-Vehicle Crashes During Various Time Periods**

# of Years Between Crashes ( <i>top row</i> ) & Probability of 0 Crashes ( <i>subsequent rows</i> )											
Crashes	Annual Average	1	2	3	4	5	6	7	8	9	10
1	0.1	<b>0.9048</b>	<b>0.8187</b>	<b>0.7408</b>	<b>0.6703</b>	<b>0.6065</b>	<b>0.5488</b>	<b>0.4966</b>	<b>0.4493</b>	<b>0.4066</b>	0.3329
2	0.2	<b>0.8187</b>	<b>0.6703</b>	<b>0.5488</b>	<b>0.4493</b>	<b>0.3679</b>	<b>0.3012</b>	<b>0.2466</b>	<b>0.2019</b>	<b>0.1653</b>	0.1353
3	0.3	<b>0.7408</b>	<b>0.5488</b>	<b>0.4066</b>	<b>0.3012</b>	0.2231	0.1653	<b>0.1225</b>	<b>0.0907</b>	0.0672	0.0498
4	0.4	<b>0.6703</b>	<b>0.4493</b>	<b>0.3012</b>	<b>0.2019</b>	<b>0.1353</b>	<b>0.0907</b>	<b>0.0608</b>	0.0408	0.0273	0.0183
5	0.5	<b>0.6065</b>	<b>0.3679</b>	<b>0.2231</b>	0.1353	0.0821	0.0498	0.0302	0.0183	0.0111	0.0067
6	0.6	<b>0.5488</b>	<b>0.3012</b>	0.1653	<b>0.0907</b>	<b>0.0498</b>	0.0273	0.0150	0.0082	0.0045	0.0025
7	0.7	<b>0.4966</b>	<b>0.2466</b>	<b>0.1225</b>	0.0608	0.0302	0.0150	0.0074	0.0037	0.0018	0.0009
8	0.8	0.4493	<b>0.2019</b>	0.0907	0.0408	0.0183	0.0082	0.0037	0.0017	0.0007	0.0003
9	0.9	<b>0.4066</b>	0.1653	0.0672	0.0273	0.0111	0.0045	0.0018	0.0007	0.0003	0.0001
11	1.1	0.3329	0.1108	0.0369	0.0123	0.0041	0.0014	0.0005	0.0002	0.0001	0.0000
12	1.2	0.3012	0.0907	0.0273	0.0082	0.0025	0.0007	0.0002	0.0001	0.0000	0.0000
13	1.3	<b>0.2725</b>	0.0743	0.0202	0.0055	0.0015	0.0004	0.0001	0.0000	0.0000	0.0000
14	1.4	<b>0.2466</b>	0.0608	0.0150	0.0037	0.0009	0.0002	0.0001	0.0000	0.0000	0.0000
15	1.5	<b>0.2231</b>	0.0498	0.0111	0.0025	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000
16	1.6	0.2019	0.0408	0.0082	0.0017	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000
19	1.9	0.1496	0.0224	0.0033	0.0005	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000

- Kearns: 5400 South, midblock between 4580 West & Northwest Av (4) – 1995 (9.1%)
- Murray: State St at Constitution Dr (4) – 1994 (6.1%)
- Salt Lake City: 300 East at 400 South (6) – 1997 (9.1%)
- Salt Lake City: 700 East at 900 South (6) – 1996 (5.0%)
- Salt Lake City: Main St at Market St (340 South) (6) – 1996 (5.0%)
- Tooele: Main St at 500 North (4) – 1994 (6.1%)
- Tremonton: Main St at Tremont St (3) – 1993 (9.1%)

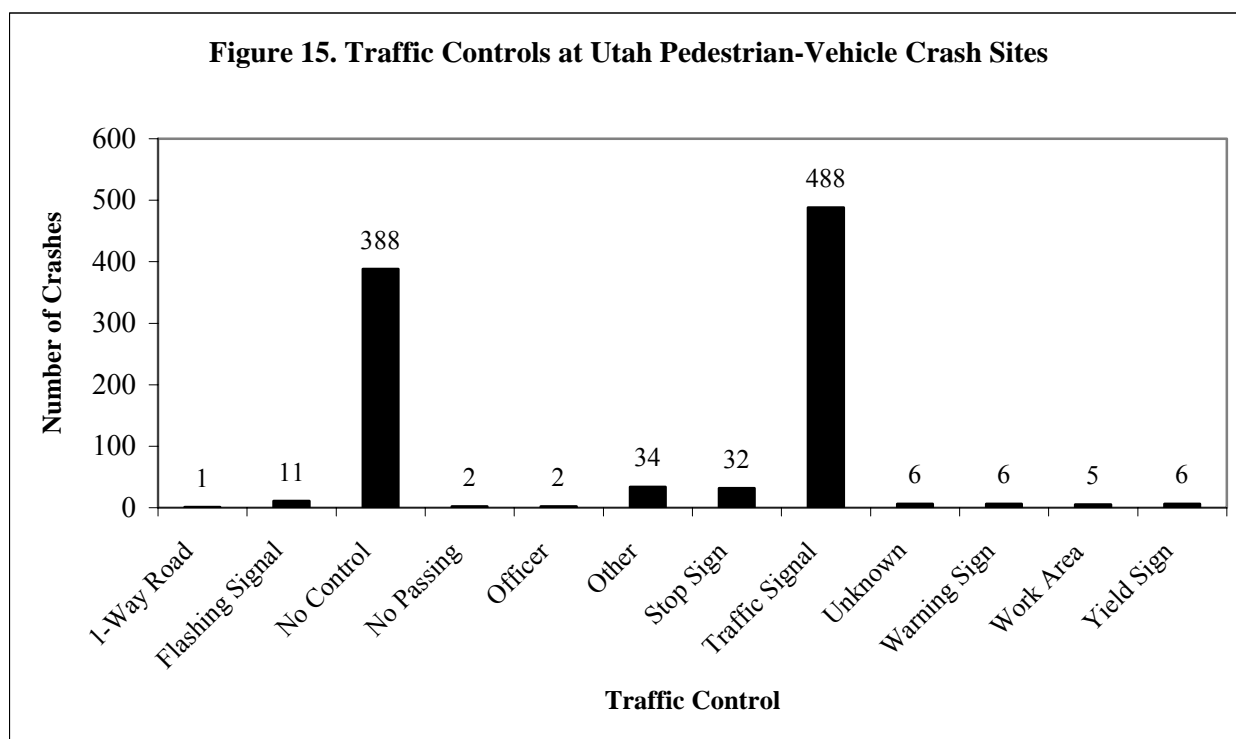
Each of the seven sites was visited by the research team as part of the project's data collection effort. TRAX construction and operation in Salt Lake City had changed the demand and supply characteristics at 300 East at 400 South, and at Main St at Market St. At the other five sites, it was not readily evident what changes, if any, had taken place since the last incident. Further study of these sites might reveal certain strategies that are effective in reducing pedestrian-vehicle incidents. The dates of traffic signal installation, street widening, median installation, lane restriping, traffic signal timing modifications, and other improvements would be needed. It would also be useful to know the physical characteristics of a site before any modifications took place. In cases in which there have been no physical changes, it would be instructive to know if any demand-related changes had occurred; these would include new developments, major openings and closures, and so forth. Changes in pedestrian trip generators would be particularly informative.

Traffic Control. In theory, the type of traffic control at each pedestrian-vehicle crash site should be the same for all crashes occurring at that site. However, the research team observed, within the CDDS, different traffic controls for the same site. The differences in traffic control type recorded may have been a result of one of the following:

- The traffic control at the location changed at some point during the study period.

- The crash occurred up to 0.03 miles upstream or downstream of an intersection, somewhat away from the intersection's control.
- The crash occurred between a vehicle turning right onto the major road and the crossing pedestrian; the traffic control, perhaps, referred to that facing the driver.
- A temporary traffic control situation, such as a construction or work zone, may have been in place at the time.

Given the above possibilities, the traffic control statistics shown in Figure 13 were observed for the 990 incidents. The majority of the incidents occurred at traffic signals (488 or 49.3%). Either "no control present" or "traffic lanes marked," both lumped together as "no control," was recorded for 388 incidents (39.2%). Only 32 crashes (3.2%) occurred at a stop sign-controlled location, while six occurred at a yield sign. A broad array of other types of control was recorded for the other crashes, including flashing signal (11 crashes or 1.1%), officer or flagman (2 crashes), warning sign (6 crashes), work area (5 crashes), and no passing zone (2 crashes). "Other" was recorded for 34 crashes (3.4%). Regarding the latter category, the type of control is supposed to be specified, but in no case was the type described. A total of 53.3% of the incidents occurred at a stop sign-, yield sign-, signal- or officer-controlled location. Locations in which the driver probably should have slowed because of a warning sign or highway work activity were the scene of 2.4% of the crashes. Most of the remaining crashes occurred at uncontrolled locations, as noted above. The implication is that just over half of the incidents occurred at controlled intersections.



## Chapter 7. Fatal Pedestrian-Vehicle Crashes at Recurrent Collision Sites

Copies of the police accident reports (PARs) on fatal pedestrian-vehicle crashes occurring at the 294 sampled sites during 2000 and 2001 were examined. A total of 52 fatal crashes occurred at 52 of the 294 sites during 2000 and 2001. Of these crashes, 33 occurred at the multiple-crash sites in the sample database. The 52 fatal crashes represented 21.6% of the 241 fatal crashes that occurred at the 294 sampled sites between 1992 and 2001. Also, the 52 fatal crashes represented 15.5% of the 335 fatal crashes that occurred throughout the State between 1992 and 2001. Given that seven sites each experienced two fatal crashes between 1992 and 2001, there were 328 fatal crash *sites*; the 52 PARs examined, therefore, represented 15.9% of all fatal crash sites. It should be noted that a representative sample of all 328 fatal crash sites would be 112 fatal crash sites; additional PARs were unavailable, however, to the research team. Further, PARs were not available for all 52 of the fatal crashes.

Table 15 lists detailed information on 27 of the fatal pedestrian-vehicle crashes, including driver and pedestrian ages and actions, suggested remedies, and related issues. The remedies were retrospectively and subjectively developed by the research team in response to the *apparent* crash causal factors. It is recognized the crash reconstruction is a complex process that would involve more detailed analysis than that done by the team. The suggested remedies were developed to identify common themes that could, in turn, be used to identify mitigating strategies.

A few additional observations on the fatal crashes are as follows. The PARs tended to be “pro-driver” in their crash descriptions. That is, the driver’s actions were typically treated as proper and appropriate for the given situation. In contrast, the pedestrian’s actions were typically described as inappropriate, such as “jaywalking,” “staggering,” or “in the street when conflicting vehicles had a green signal.” One concern is that a pedestrian’s actions are evident to a bystander, and can readily be subject to fact-based criticism. Contrarily, a driver’s actions may be unknown to a bystander; for example, a driver could be distracted – perhaps adjusting a radio or eating – but no one would be aware of this. This lack of awareness of driver actions tends to bias PARs toward criticism of the pedestrians’ behavior. In fact, in most of the fatal crashes investigated, the driver was not cited. None of the PARs mentioned the type of clothing worn by the struck pedestrian(s). This is critical information, as research has shown that a pedestrian is much more visible when wearing bright or reflective clothing than when wearing dark clothing.

**Table 15. Fatal Pedestrian-Vehicle Collisions at Single and Recurrent Crash Sites (2000-2001)**  
**2000**

<b>Date</b>	<b>Day</b>	<b>Time</b>	<b>Conditions &amp; Location</b>	<b>Driver &amp; Pedestrian Ages &amp; Actions</b>
1/3	M	1149	Day, cloudy Murray 700 East at 4578 South	<u>Driver</u> : male, 53, school bus, discharged girl then pulled off <u>Pedestrian</u> : female, 5, "slipped on snow and fell under bus" <u>Remedy</u> : <i>improve snow removal at pavement-sidewalk interfaces; require school bus drivers to watch children walk away from bus</i> <u>Issues</u> : <i>school bus driver training; child pedestrian safety education; parental involvement in school trips</i>
1/10	M	1800	Dark, raining Ogden Washington Bl at 5 <sup>th</sup> St	<u>Driver</u> : male, 60, SOI 30, "did not see pedestrian" <u>Pedestrian</u> : female, 48, "at intersection; no crosswalk" <u>Remedy</u> : <i>provide crosswalk &amp; signing; improve lighting; improve pedestrian visibility (clothing, flashing crosswalk)</i> <u>Issues</u> : <i>driver awareness of pedestrians</i>
1/14	F	2054	Dark, clear Salt Lake City 300 West at 300 South	<u>Driver</u> : unknown (hit & run), SOI 50 <u>Pedestrian</u> : male, 32, "crossing against signal; staggering" <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing); curb drunk pedestrianism</i> <u>Issues</u> : <i>pedestrians &amp; alcoholism; penalty for hit &amp; run</i>
1/18	Tu	1832	Dark, clear S. Salt Lake State St at 3400 South	<u>Driver</u> : male, 33, "did not see pedestrian" <u>Pedestrian</u> : female, 48, "standing in lane; no crosswalk" <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing); increase crossing opportunities</i> <u>Issues</u> : <i>pedestrian safety education</i>
4/2	Su	0142	Dark, clear S. Salt Lake 700 East at 3300 South	<u>Driver</u> : male, 20 <u>Pedestrian</u> : male, 47, "crossing against signal; staggering" <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing); curb drunk pedestrianism</i> <u>Issues</u> : <i>pedestrians &amp; alcoholism</i>
5/7	Su	0041	Dark, raining Ogden Monroe Bl at 29 <sup>th</sup> St	<u>Driver</u> : male, 18, SOI 30, "did not see pedestrian; did not stop, but was stopped by witnesses" <u>Pedestrian</u> : male, 35, "laying in road on back prior to crash" <u>Remedy</u> : <i>improve lighting; strengthen penalty for hit &amp; run</i>
5/25	Th	2159	Dark, raining Salt Lake City State St at 400 South	<u>Driver</u> : male, 20, SOI 30, "no time to react" <u>Pedestrian</u> : male, 38, "stepped off median in front of car" <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing)</i> <u>Issues</u> : <i>pedestrian safety education</i>
6/16	F	1205	Daytime, clear Bountiful Main St at 650 South	<u>Driver</u> : male, 70, SOI 31, "did not see pedestrian" <u>Pedestrian</u> : female, 92, "crossing westbound in crosswalk" <u>Remedy</u> : <i>improve pedestrian visibility (clothing, flashing crosswalk)</i> <u>Issues</u> : <i>driver awareness of pedestrians</i>
7/6	Th	1411	Daytime, clear Riverton Redwood Rd at 12888 South	<u>Driver</u> : female, 35 <u>Pedestrian</u> : male, 8, "ran across road after getting object" <u>Remedy</u> : <i>child pedestrian safety education, involving parents</i> <u>Issues</u> : <i>driver awareness of pedestrians</i>

**Table 15 (continued)**

<b>Date</b>	<b>Day</b>	<b>Time</b>	<b>Conditions &amp; Location</b>	<b>Driver &amp; Pedestrian Ages &amp; Actions</b>
7/13	Th	0430? 2330	Dark, clear Logan Main St at 100 South	<u>Driver</u> : female, 29, SOI 30, “did not see; tried to swerve” <u>Pedestrian</u> : female, 80, “with male, 84; jaywalking” <u>Remedy</u> : <i>improve lighting, improve pedestrian visibility (clothing)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
10/11	W	0639	Dark, raining S. Salt Lake State St at 3900 South	<u>Driver</u> : male, 19, SOI 25, “did not see pedestrians” <u>Pedestrians</u> : female, 43, male, 73, “crossing 8-lane arterial, at median when signal turned red, tried to complete crossing” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing; flashing crosswalk)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
10/28	Sa	2004	Dark, clear Perry US 89 at 1900 South	<u>Driver</u> : male, 21, SOI 53, “did not see pedestrians” <u>Pedestrian</u> : female, 55, “crossing US 89” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing); increase crossing opportunities</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education; speed limit adjacent retail development</i>
11/19	Su	1826	Dark, clear Provo University Av at Univ. Pkwy	<u>Driver</u> : male, 23, SOI 35, “did not see; tried to swerve” <u>Pedestrian</u> : female, 23, “in crosswalk, against signal; with two others” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing, flashing crosswalk)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education; group pedestrian behavior</i>
12/6	W	1523	Daytime, clear Grantsville Main St at Center St	<u>Driver</u> : male, 68, SOI 30, “did not see pedestrian” <u>Pedestrian</u> : female, 7, “in crosswalk, had cleared stopped left-turning vehicles” <u>Remedy</u> : <i>child pedestrian safety education, involving parents; school crossing protection (guard, reduced speed limit, signing, advance warnings to drivers)</i> <u>Issues</u> : <i>driver awareness of pedestrians</i>
12/18	M	1441	Daytime, clear Salt Lake City 900 West at 671 North	<u>Driver</u> : male, 41, “struck pedestrian when passing vehicle that had stopped for pedestrian; stopped vehicle used emergency flashers; license under suspension” <u>Pedestrian</u> : female, 38, “crossing not in crosswalk” <u>Remedy</u> : <i>improve pedestrian visibility (clothing)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
12/23	Sa	0133	Dark, cloudy Little Cottonwood Highland Dr n/o 8150 South	<u>Driver</u> : male, 24, hit & run, returned later, claimed that he “hit a deer” <u>Pedestrian</u> : male, 22, “was crossing road” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education; penalty for hit &amp; run</i>

**Table 15 (continued)****2001**

<b>Date</b>	<b>Day</b>	<b>Time</b>	<b>Conditions &amp; Location</b>	<b>Driver &amp; Pedestrian Ages &amp; Actions</b>
1/11	Th	0700	Dark, clear Pioneer Rd at 1880 south	<u>Driver</u> : male, 35, “did not see pedestrian” <u>Pedestrian</u> : male, 46, “in roadway, wearing dark clothing; not in crosswalk (nearest crossing 150 ft south)” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
1/23	Tu	1805	Dark, clear Ogden Wall Av at 4 <sup>th</sup> St	<u>Driver</u> : female, 17, SOI 48, “struck pedestrian after swerving to avoid vehicle completing left turn from cross street” <u>Pedestrian</u> : male, 20, “pushing stroller, not in crosswalk; baby injured” <u>Remedy</u> : <i>reduce speed limit; improve lighting; improve pedestrian visibility (clothing)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
1/26	F	1852	Dark, clear Logan 1400 North at 200 East	<u>Driver</u> : male, 21, “did not see pedestrian” <u>Pedestrian</u> : male, 70, “in crosswalk, signal not functioning” <u>Remedy</u> : <i>pedestrian signal head maintenance; improve lighting; improve pedestrian visibility (clothing, flashing crosswalk)</i> <u>Issues</u> : <i>driver awareness of pedestrians</i>
6/21	Th	1133	Daytime, clear S. Salt Lake State St at Claybourne Av	<u>Driver</u> : male, 42, SOI 60, “driver was speeding; not cited” <u>Pedestrian</u> : female, 87, female, 65, “ran across road” <u>Remedy</u> : <i>speed limit enforcement; increase crossing opportunities; improve pedestrian visibility (clothing)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
6/23	Sa	2140	Dark, cloudy Ogden Monroe Bl at 27 <sup>th</sup> St	<u>Driver</u> : unknown (hit & run), SOI 40 <u>Pedestrian</u> : male, 53, “struck while crossing at intersection” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing, flashing crosswalk); strengthen penalty for hit &amp; run; speed limit enforcement; reduce speed limit</i> <u>Issues</u> : <i>driver awareness of pedestrians</i>
8/23	Th	2243	Dark, clear Ogden Washington Bl at River Dr	<u>Driver</u> : female, 32, SOI 45 <u>Pedestrian</u> : male, 46, “on crutches, walked into path of car” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing); increase crossing opportunities</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
10/5	F	1926	Dark, clear Springville Main St at 245 South	<u>Driver</u> : male, 28, SOI 30 <u>Pedestrian</u> : male, 64, “not in crosswalk, was at fault” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing); increase crossing opportunities</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>

**Table 15 (continued)**

<b>Date</b>	<b>Day</b>	<b>Time</b>	<b>Conditions &amp; Location</b>	<b>Driver &amp; Pedestrian Ages &amp; Actions</b>
10/12	F	0749	Daytime, clear West Valley 4225 South at 4000 West	<u>Driver</u> : male, 31, “did not see pedestrian; failed to stop when making right turn; did not stop after collision” <u>Pedestrian</u> : female, 67, “attempting to cross at corner” <u>Remedy</u> : <i>right turn channelization; stop sign enforcement; improve pedestrian visibility (clothing, flashing crosswalk)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
10/17	W	0045	Dark, clear S. Salt Lake 3300 South at 277 West	<u>Driver</u> : male, 27 <u>Pedestrian</u> : male, 40, “not in crosswalk” <u>Remedy</u> : <i>improve lighting; improve pedestrian visibility (clothing)</i> <u>Issues</u> : <i>driver awareness of pedestrians; pedestrian safety education</i>
10/25	Th	2055	Dark, clear S. Salt Lake State St at 3300 South	<u>Driver</u> : male, 43, SOI 35 <u>Pedestrian</u> : male, 21, “car stalled in left lane; exited car on passenger side and fell; struck while on hands & knees” <u>Remedy</u> : <i>improve lighting</i> <u>Issues</u> : <i>driver education regarding disabled vehicles; driver behavior near stopped vehicles</i>
11/20	Tu	1826	Dark, clear Salt Lake City 100 South at 1000 East	<u>Driver</u> : female, 30, “did not see pedestrians” <u>Pedestrian</u> : female, 80, “in crosswalk with male, 87 (also struck); no controls on cross-street” <u>Remedy</u> : <i>improve lighting, improve pedestrian visibility (clothing, flashing crosswalk); advance warning of crossing</i> <u>Issues</u> : <i>driver awareness of pedestrians</i>

NOTES: M = Monday, Tu = Tuesday, W = Wednesday, Th = Thursday, F = Friday, Sa = Saturday, Su = Sunday.  
Time of day is in military format. SOI = estimated speed on impact.

## CHAPTER 8. Evaluation of Effectiveness of Existing Pedestrian Crossing Enhancements

### Countdown Pedestrian Indicators

Of the 294 sites in the pedestrian-vehicle crash site sample, 17 had been enhanced with the installation of countdown pedestrian indicators (CPIs) at the time of the research team's field investigation. Fifteen of the 17 sites were located in Salt Lake City, one was in South Salt Lake, and one was in Millcreek, an unincorporated urbanized area in Salt Lake County. Field studies were done at 14 of the sites, including 12 in Salt Lake City, and the ones in South Salt Lake and Millcreek. The objectives were to examine pedestrian behavior at locations known to have experienced recurring pedestrian-vehicle crashes, and to ascertain pedestrian usage of the enhancements. At all 14 of the sites, the CPI had been installed since the Fall of 2000, which is when the first CPI was "unveiled" in Salt Lake City. Some CPIs were installed prior to the 2002 Winter Olympic Games, which were held in February of that year in and around Salt Lake City, while some have been installed since. The research team did not attempt to determine the installation time of each CPI in the sample. Given the short post-installation period, it was not possible to evaluate the effectiveness of the CPIs in terms of pedestrian-vehicle crashes forestalled. The research team, nonetheless, observed pedestrians at the following sites (all in Salt Lake City, unless otherwise noted). A "+" indicates that all four crossings at the intersection were studied; an "at" indicates that only the two crossings of the first street listed were examined. At the South Salt Lake and Millcreek locations, however, there was only one marked crossing:

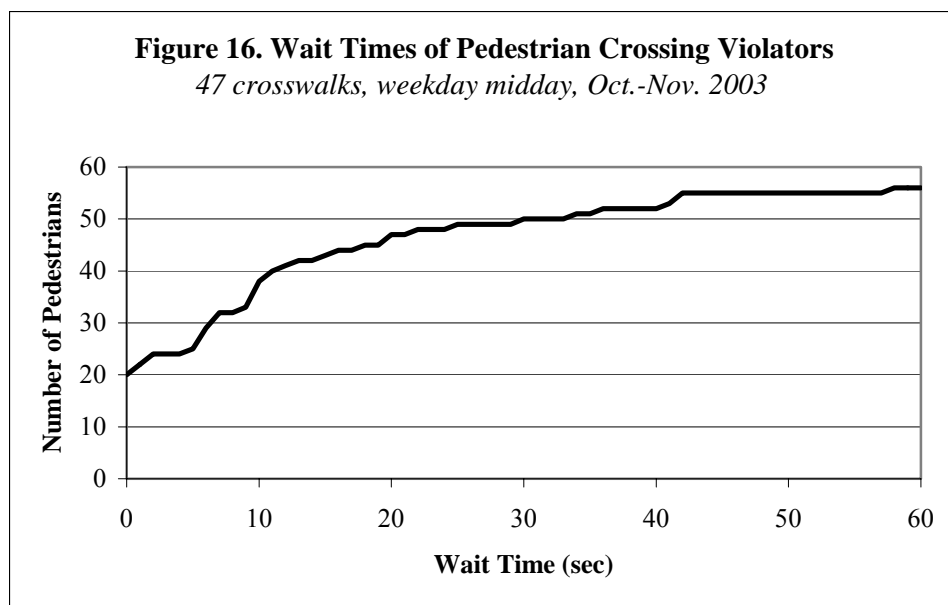
- Highland Drive-1100 East + 2100 South
- South Temple + State Street
- State Street + 400 South
- State Street at Sunset Avenue (*South Salt Lake*)
- West Temple + South Temple
- 200 East + 200 South
- 200 South + State Street
- 200 South + West Temple
- 300 East + 400 South
- 300 South + State Street
- 300 South + West Temple
- 300 West at 300 South
- 400 South at Main Street
- 4500 South at 500 East (*Millcreek*)

A total of 47 crosswalks were investigated in the study. At ten of the sites – that is, in 40 of the crosswalks – only one direction of pedestrian travel was studied. Limited manpower prevented the study of both directions. At four of the sites (seven of the crosswalks), both walking directions were examined in the crosswalks studied. Each site was studied for about 30 minutes, as shown in the Appendix. In general, the data were collected between October 27<sup>th</sup> and November 12<sup>th</sup>, 2003 during a midday period (most commonly for a half-hour sometime between 11:30 AM and 1:40 PM). Some of the crosswalks at the same site were visited at different times. One crosswalk was visited during the late afternoon (5:00 to 5:30 PM), while another was visited in the morning (8:00 to 8:30 AM). One site, State Street at Sunset Avenue, was visited on a Saturday. Pedestrians were classified according to their approximate age (child, adolescent or adult, elderly) and physical ability (able, disabled). Pedestrians were not classified by gender. Pedestrians were also identified as "units" of one or more persons, recognizing that pedestrians in groups would tend to exercise similar crossing behavior. In such cases, the field technician attempted to identify the "lead" pedestrian in the unit, and subsequently classify the leader's age. Driver approach speeds and behavior were not formally observed. Three situations were observed and recorded:

- Pedestrian arrives at the crossing when the signal is red (steady “don’t walk” hand),
- Pedestrian arrives at the crossing when the signal is green (steady walking man), and
- Pedestrian arrives at the crossing during the countdown.

If the pedestrian arrived when the signal was red, the wait time until the “walking man” appeared was timed. If the pedestrian was a violator – that is, did not wait for the green phase – then the wait time until the violation occurred was recorded. If the pedestrian arrived during the countdown, the amount of time remaining on the indicator was recorded, along with the pedestrian’s action (walk, run, or wait). A special notation was made each time a pedestrian was “caught” in the intersection at CPI = 0.

A total of 987 pedestrian “units” were observed at the 14 sites. Nearly all (881 or 89.3%) of the pedestrians or “group leaders” were adult or adolescent. A total of 66 (6.7%) pedestrian “units” were identified as elderly, 32 (3.2%) were identified as children, and eight (0.8%) were disabled. Most of the pedestrians – 570 or 57.8% -- arrived when the pedestrian signal was red. Of these, 512 (89.8%) waited until the “walking man” appeared before crossing. The remaining 58 pedestrian “units” acted in one of two fashions upon arriving on a red signal. A total of 38 persons or groups waited for a time ranging from 1 to 58 seconds, then violated the signal by crossing on a “steady hand.” The other 20 pedestrian “units” violated the signal and crossed without waiting. These findings indicate that some pedestrians, perhaps, grew impatient at having to wait a long time for a green signal. The distribution of wait times before a violation is presented in Figure 11. The figure shows that 24 pedestrian “units” waited for 0 to 2 seconds before violating the red crossing signal. An additional 14 persons or groups violated the red signal after waiting for 5 to 10 seconds. One criticism of pedestrian signals is that many are not quickly responsive to pedestrian actuation. These findings indicate, though, that only 20 (34.5%) of the violators had to wait for more than 10 seconds at any crossing. For 38 (65.5%) of the violators, the wait time was less than 10 seconds. In these cases, there was no opportunity for the pedestrian signal to “demonstrate” its responsiveness. It may be that these pedestrians based their decisions to violate on experiences with other, unresponsive signals; that is, it was assumed that the given signal would not be responsive, leading to a crossing during the “steady hand.” It may have also been that some or all of these pedestrians were impatient, such as those who crossed without waiting, and no response time would have been satisfactory. The only mitigation for this small group of pedestrians (10.2% of all who arrived on the red signal were violators; 6.7% of all who arrived on red waited 10 seconds or less) might be enforcement.



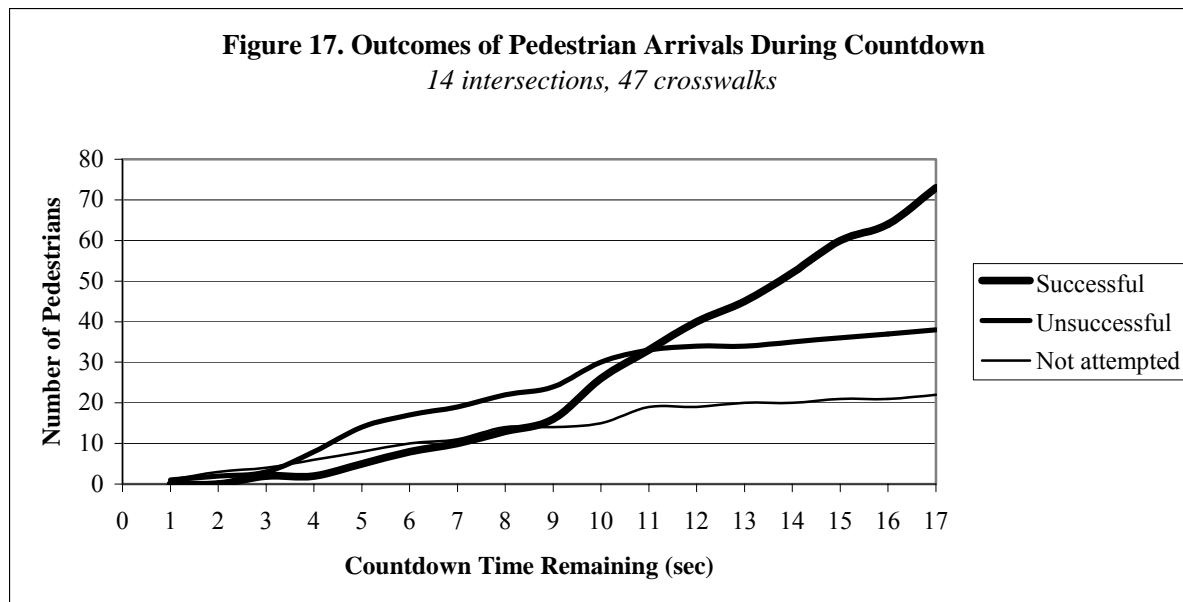
A total of 261 pedestrian “units” (26.4%) arrived at a crossing when the walking man was displayed. These pedestrians were fortunate in that they did not have to wait for a green signal, plus they were able to start their crossings before the countdown began. The remaining 153 pedestrian “units” (15.5%) arrived at a crossing after the countdown had started. These groups were divided into three categories. Ninety-three pedestrian “units,” or 60.8% of those arriving after the countdown had started, successfully completed the crossing before the CPI reached zero. Twenty-two persons or groups, or 14.4%, elected not to cross upon noting the time remaining on the CPI. The longest time observed at which a crossing was not started was 17 seconds. Finally, 38 persons or groups (24.8%) elected to cross and were caught in the intersection when the CPI reached zero. In all cases these pedestrians successfully crossed, but delays to motor vehicles on the conflicting approach were observed.

Further analysis of the pedestrians arriving during the countdown was done. The arrival times of the pedestrians were unevenly distributed among the countdown times. The number of arrivals ranged from two at CPI = 1 to 17 at CPI = 10. A uniform distribution of pedestrian arrival times would be ideal. Arrivals were recorded at each countdown time from 1 to 20 seconds; a single arriving “unit” was recorded for CPI = 23, CPI = 24, and CPI = 28. An ideal database would feature a large, uniform number of arrivals at each CPI time; then, the actions of the pedestrians as a function of CPI time could be evaluated. The width of the crossing would need to be incorporated into the analysis. The data are summarized in Figure 15 and Table 16. As expected, the portion of walkers who successfully completed a crossing decreased as the CPI decreased. Similarly, the portion of pedestrians who either stopped before crossing or crossed and were “caught” increased as the CPI decreased. Figure 12 shows that a “kernel” occurred between CPI = 9 and 11 sec. At CPI < 9 sec, the number of pedestrians who either did not attempt to cross or who were unsuccessful in crossing before the time expired was greater than the number who successfully crossed. At CPI > 11 sec, the number of pedestrians who were successful was greater than the number who either stopped or were unsuccessful. The 60 pedestrian “units” who either stopped or were unsuccessful might be classified as pedestrians who arrive at a CPI and cannot cross successfully. Of these 60, 22 (36.7%) made a “good” decision in choosing not to cross; that is, these pedestrian “units” were able to evaluate the time remaining and elected not to attempt the crossing. A total of 38 (63.3%) perhaps made a “bad” decision and proceeded to cross, getting caught in the intersection at CPI = 0. This finding suggests that a large portion of pedestrians were unable to properly assess the time remaining. A possible mitigation would be to supplement the CPI with a “recommended crossing time” (perhaps on a sign adjacent the ped head), or a “do not start” message within the ped head when the CPI reaches a limiting value. The research team observed that the shortest time at which a pedestrian *walked* and successfully crossed was six seconds. Successful crossings with little remaining CPI time were, as expected, associated with relatively narrow crossings (such as Highland Drive at 2100 East). Four successful crossings were made with CPI < 5 sec, but these pedestrians were all observed to be “runners,” either running to get across the street or ascertained to be out running for exercise. It is recommended that additional data be collected at intersections with CPIs to confirm these findings.

Of the 987 pedestrian “groups” studied, 75 were “caught” in the intersection at CPI = 0. About half of these (38) were referred to in the previous paragraph as pedestrians who arrived at the crossing during the countdown, but were unable to complete crossing before the countdown expired. The other half of these (37) began to cross during the steady walking man, but were still crossing at CPI = 0. The indication is that the amount of green time allocated was too short for about 3.7% of all pedestrian “units.”

### Crossing Flags

Only two of the sampled pedestrian-vehicle crash sites featured crossing flags upon field inspection: 100 South at 1000 East, and 1700 South at 600 East in Salt Lake City. Neither intersection was signalized at the time of field investigation. Before the list of sampled sites was finalized, the research team visited two sites with crossing flags which were ultimately *not* included among the 294 sampled sites. The infor-



mation gathered at the two sites was nonetheless useful to this research. Two crosswalks equipped with crossing flags were visited: 100 South at North Campus Drive in Salt Lake City, and 900 East at 450 North in Provo. The former crossing is located at the cross-section of a 90° bend in SR 282; west of the bend, SR 282 becomes 100 South, while north of the bend, SR 282 becomes North Campus Drive. The road is continuous through the crossing, and there are no controls at the crossing. The latter crossing is located on the north side of a T-intersection between 900 East, which runs north-south, and 450 North, which begins at and continues eastward from 900 East. Both crossings are similar in that they are located adjacent universities: 100 South at North Campus Drive is located adjacent the University of Utah, while 900 East at 450 North is located immediately to the southeast of Brigham Young University. There are four through lanes at both locations, and the speed limit is 35 MPH at both sites. (To be more accurate, the speed limit at 100 South at North Campus Drive is 35 MPH to the north of the crossing, and 30 MPH to the west). The traffic volumes at the two sites were similar in 2002. Since both locations serve a similar “clientele” – predominantly university students, faculty, staff, administrators and visitors, presumably from similar age groups – and featured similar infrastructure and motor vehicle volumes, the data from the two sites were combined.

A summary of the data collected at the two crossings is provided in Table 17. The crossing at 100 South and North Campus Drive was visited on Tuesday, April 29<sup>th</sup>, 2003 from 12:30 to 1:35 PM, for a duration of 65 minutes. The crossing at 900 East and 450 North was visited on Friday, October 10<sup>th</sup>, 2003 from 12:12 to 1:42 PM, for a duration of 90 minutes. Both crossings, therefore, were visited on a weekday during a midday-lunch period. School was in session on both dates. A total of 157 pedestrians were counted crossing at the two locations. Since pedestrians in pairs or groups exhibit similar crossing behavior, a pedestrian “unit” was defined as a single person or a group of two or more persons. A total of 97 pedestrian “units” crossed during the 155 minutes of observation. (The average pedestrian “unit” size was 2.12 persons). Nine pedestrian units (9.3%) were observed to use the crossing flags. It was observed that 20 pedestrian units arrived when no motor vehicle was approaching. Presuming that a pedestrian would not use a flag when there was no potential for a conflict with a motor vehicle, then 77 pedestrian units were *eligible* for usage of a crossing flag. The nine pedestrian units that *did* use a flag represented 11.7% of those eligible. Driver behavior was examined closely only at the Provo crossing. Three pedestrian units used the crossing flags there; in two cases, approaching drivers stopped immediately. In the third case, two motor vehicles passed before the drivers either stopped or the pedestrian unit had a sufficient gap in crossing traffic.

**Table 16. Pedestrian Actions During Countdown**

<b>Time Remaining</b>	<b>Successfully Crossed</b>	<b>“Unsuccessfully” Crossed</b>	<b>Did Not Attempt to Cross</b>	<b>Pedestrians Observed</b>
1	0.0%	50.0%	50.0%	2
2	0.0%	33.3%	66.7%	3
3	50.0%	25.0%	25.0%	4
4	0.0%	71.4%	28.6%	7
5	27.3%	54.5%	18.2%	11
6	37.5%	37.5%	25.0%	8
7	40.0%	40.0%	20.0%	5
8	33.3%	33.3%	33.3%	9
9	60.0%	40.0%	0.0%	5
10	58.8%	35.3%	5.9%	17
11	50.0%	21.4%	28.6%	14
12	87.5%	12.5%	0.0%	8
13	83.3%	0.0%	16.7%	6
14	87.5%	12.5%	0.0%	8
15	80.0%	10.0%	10.0%	10
16	80.0%	20.0%	0.0%	5
17	81.8%	9.1%	9.1%	11
18	100.0%	0.0%	0.0%	9
19	100.0%	0.0%	0.0%	4
20	100.0%	0.0%	0.0%	4
21	No data	No data	No data	0
22	No data	No data	No data	0
23	100.0%	0.0%	0.0%	1
24	100.0%	0.0%	0.0%	1
25	No data	No data	No data	0
26	No data	No data	No data	0
27	No data	No data	No data	0
28	100.0%	0.0%	0.0%	1
<b>TOTAL</b>	<b>93</b>	<b>38</b>	<b>22</b>	<b>153</b>

The waiting times of pedestrians at the two crossings, for the 77 pedestrian units who were faced with approaching vehicles, ranged from 0 to 20 sec. The overall average wait time was 2.09 sec. Nineteen, or about one-fourth of the pedestrians had a wait time of 0 sec. These pedestrians chose not to wait despite the fact that motor vehicles were approaching. No pedestrian-vehicle collisions were witnessed, but motor vehicle-pedestrian conflicts were associated with the non-waiting pedestrians. Excluding the pedestrians who elected not to wait, then 58 pedestrian units (59.8% of those observed) waited for an average of 2.78 sec each. This waiting time *should* be acceptable to most pedestrians. The research team did not distinguish between drivers who *chose* to stop and drivers who were *forced* to stop. Not enough pedestrians used the crossing flags to generate a database of pedestrian and motorist behavior.

**Table 17. Infrastructure and Performance at Crosswalks with Crossing Flags**

<b>Data Item</b>	<b>Provo</b>	<b>Salt Lake City</b>	<b>Both Locations</b>
Location	900 East at 450 North	100 South at North Campus Drive	155 minutes
Date	October 10, 2003	April 29, 2003	
Day	Friday	Tuesday	
Time	12:12-1:42 PM	12:30-1:35 PM	
Duration	90 minutes	65 minutes	
Route	490965	SR 282	35
AADT (2002)	20,615	8,200	
Speed Limit	35	35 north; 30 west	
Lanes	4	4	
Pedestrians crossing	101	56	
Pedestrian "units"	55	42	97
Pedestrian "unit" size	Range: 1-9 Avg: 1.84	Range: 1-7 Avg: 1.17	Range: 1-9 Avg.: 1.62
Pedestrians using flag	3	6	9
Pedestrians xing outside markings	8	0	8
Pedestrians arriving when no cars	18	2	20
Pedestrian wait time	Range: 0-20 sec Avg (cars): 2.70 sec	Range: 0-6 sec Avg (cars): 1.53 sec	Range: 0-20 sec Avg (cars): 2.09 sec
Driver reaction to flag	Stopped: 2 Passed: 1	NA	NA

## CHAPTER 9. References

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## CHAPTER 10. Project Participants

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